energies

MDPI

Article

Design of the Model of Optimization of Energy Efficiency Management Processes at the Regional Level of Slovakia

Martin Rovňák [1,*], Alexander Tokarčík [2], Lenka Štofejová [1], Roman Novotný [1], Peter Adamišin [1] and Matúš Bakoň [1]

[1] Department of Environmental Management, Faculty of Management, University of Prešov, Konštantínova 16, 080 01 Prešov, Slovakia; lenka.stofejova@smail.unipo.sk (L.Š.); roman.novotny@smail.unipo.sk (R.N.); peter.adamisin@unipo.sk (P.A.); matus.bakon@unipo.sk (M.B.)

[2] Energy Cluster of Presov Region, Levočská 12, 080 01 Prešov, Slovakia; alexander.tokarcik@gmail.com

* Correspondence: martin.rovnak@unipo.sk

Abstract: This paper focuses on the issue of energy efficiency management in the region of Prešov self-governing region (PSR), Slovakia, as the energy market is liberalized and the behavior of electricity consumers is influenced not only by conventional but also by alternative suppliers of this type of energy. Based on the statistical evaluation of a questionnaire survey focused on the emotional, behavioral, and cognitive behavior of consumers, a model of optimization of system processes of energy efficiency management at the regional level is presented. A one-way ANOVA and *t*-test were used to determine statistically significant differences, and Pearson's correlation coefficient was used to determine a statistically significant relationship. Based on the obtained results, a suitable candidate for efficient electricity management is an employee aged 36 to 50 with a technical focus. The proposed model of optimizing the processes of energy management efficiency at the regional level can also be applied to the supraregional level in the understanding of the geographical division of the European Union, where the same legislative regulations are applied within the liberalized electricity market.

Keywords: energy efficiency management; energy efficiency; energy optimization

Citation: Rovňák, M.; Tokarčík, A.; Štofejová, L.; Novotný, R.; Adamišin, P.; Bakoň, M. Design of the Model of Optimization of Energy Efficiency Management Processes at the Regional Level of Slovakia. *Energies* **2021**, *14*, 6502. https://doi.org/10.3390/en14206502

Academic Editor: Carlo Roselli

Received: 25 May 2021
Accepted: 7 October 2021
Published: 11 October 2021

1. Introduction

In response to climate change, energy efficiency requirements have recently increased in most energy-intensive industries. For buildings, this means targeting building managers, as well as building users, to identify potential energy savings and promote more energy-responsible behavior [1]. Energy efficiency in buildings can be increased through several measures: adopting and promoting more energy-efficient behavior; helping building managers to maximize energy savings; and the automation of optimization of energy consumption, production, and storage of some equipment without reducing the level of comfort and quality parameters of the working environment in the interior [2].

Building an energy management system in regional conditions is based on the ability to adapt to new solutions required by this issue. Its basic condition is the ability of top management to make a clear decision that will ensure continuous improvement in energy management. For most service users in the industry and the public sector, energy management represents a new direction for the future. Jin-Zhao [3] argues that all employees are involved in energy savings, which is important for the overall management of energy in achieving energy savings. Many shortcomings in energy savings can be found by employees working at the lowest level. The design of an overall energy efficiency management system should undergo a systematic analysis. A systems analysis must be based on information that is an image of the objective reality of energy consumption. Therefore, information and records on existing energy consumption should be collected first, and then energy management should be built. Energy management, according to

Kučera [4], is a combination of management, financial, engineering, and other procedures applied to energy activities to provide the required level of energy security activities of the economic unit in the most cost-effective way. The basis of energy management is a detailed knowledge of the geospatial and technological configuration of energy infrastructure, its normative technical parameters with their elasticity, time courses of use of energy commodities and water, and quantitative data about them. According to Gruber and Prodanovic [5], energy management takes into account the physical limitations of the system, and calculates optimal planning by minimizing the economic index at each stage of optimization. Závadský et al. [6] claim that energy management is responsible for activities that address energy management. Thus, energy management can be perceived as a process in which the manager, as a management system, acts through management processes on employees, as a managed system, to achieve operational and strategic goals of the organization. Energy management should rely on the strategy adopted by top management in energy management.

In recent years, the process of energy management has gained importance due to technological progress as well as socio-economic development. However, this process requires the continuous integration of low-carbon technologies and renewable energy sources in the regions. This means developing energy management activities concerning the environment in such a way that the needs of current generations do not jeopardize the needs of future generations. Based on these facts, it is possible to identify with Huttmanova and Adamisin [7], who state that sustainable development is a targeted, long-term (ongoing), complex, and synergistic process, influencing conditions and all aspects of life (cultural, social, economic, environmental, and institutional), at the regional level. We are working towards a functional model of the regional community that satisfies the biological, material, spiritual, and social needs and interests of people; eliminates or significantly reduces interventions threatening, damaging, or destroying conditions and life forms; does not deteriorate the environment beyond tolerable levels; uses its resources wisely; and protects the cultural and natural heritage they present as sustainable development. The opinion of the European Committee [8] on the governance of the Energy Union and clean energy sets out the approach of regions and administrations at the national level towards energy transformation. Given the politically recognized role of local and regional authorities in implementing sustainable energy policy, and taking into account the European Committee's objective of better regulation, national authorities are required to involve local and regional authorities in planning and monitoring following the constitutional and political conventions of individual Member States. The fact that energy is one of the priority topics of the European Union is also indicated by the comprehensive body of legislative documents focused on energy security, climate and environmental aspects, and social and economic aspects of energy policy [9,10]. The issue of increasing the energy efficiency, reducing greenhouse gases, and increasing the share of renewable energy sources affects all EU member states as the EU aims to become the first climate neutral continent by 2050 [11]. In a spirit of partnership, Member States should engage in a permanent energy dialogue to promote the active involvement of local and regional authorities, civil society organizations, businesses, investors, and any other relevant stakeholders, as well as the general public in managing energy transformation and tackling energy poverty.

From the perspective of building energy management that ensures the implementation of the Sustainable Energy Action Plan (SEAP), according to Watson [12], all stakeholders must have a clearly defined key role in addressing the energy and climate challenge in cooperation with local authorities. The energy management built in this way is intended to create a common vision for the future with the participants, to define the paths they will take concerning the visions and findings, to invest the necessary human and financial resources. The views of citizens and stakeholders should be known before drawing up detailed plans. Therefore, citizens and other stakeholders should be offered the opportunity to participate in the key phases of the SEAP already in the preparation process: building a vision, defining objectives, setting priorities, etc.

Only a thorough knowledge of the local situation in terms of energy and greenhouse gas emissions will ensure that energy management can set relevant targets for the EnMS, and then monitor their achievement and evaluate them. There is a Partnership Agreement between the Directorate-General for Energy of the European Committee and the Prešov Region [13] as the Convention of Mayors in the Prešov Region, in which the PSR evaluates the Convention of Mayors and the results achieved by it since its launch. This is the main reason why the PSR decided to support the implementation of the Convention in the cities and municipalities in its territory. PSR also helps local governments that decide to formalize their commitment to the Convention. To this end, the PSR is willing to launch a specific program to support local councils to meet the conditions for admission to the Covenant of Mayors, and to prepare an Action Plan for Sustainable Energy Development at the local level [14].

Chudík [14] declared PSR's participation in the systematic support of reducing energy intensity. A significant step forward in the energy field is the involvement of the self-governing region in the ELENA program. It is an instrument of the European Investment Bank financed by the European Union. The investment program is focused on reducing the energy intensity of public buildings (building insulation, solar water heating, photovoltaic electricity generation, and modernization of interior lighting in buildings) and modernization of public lighting systems. PSR is interested in making large investments that will lead to increased energy efficiency and renewable energy sources. Therefore, the Prešov self-governing region, in cooperation with 14 towns and villages, received technical assistance from ELENA. Fitzeková [15] presented a plan to use EUR 60 million for energy investments through the ELENA program, and another EUR 50 million will be reinvested in energy efficiency thanks to the European Investment Bank.

If we rely on Act No. 321/2014 [16] on energy efficiency, then energy management manages the energy consumed by the final consumer. Energy management, as an expert group, aims to achieve energy savings in a given period that are cost-effective with the appropriate implementation of renewable energy sources, while setting measures to improve energy efficiency concerning energy security at the endpoint of consumption. Through its activities, energy management proposes gradual steps influencing energy consumption and savings, including an assessment of cost-effectiveness taking into account the commitments made by top management. Energy management develops and updates a long-term strategy for activating investments in the renewal of technological and technical equipment, as well as in the renewal of real estate. It helps to conclude and implement the energy service, which is provided based on a contract between the energy service provider and the recipient of the energy service, as a result of which there are demonstrably verifiable, measurable, or estimable energy savings. At the same time, there is an improvement in energy efficiency, which makes it possible to achieve a financial or material advantage for all parties obtained through a more energy-efficient technology or activity. This activity includes the operation, maintenance, or inspection necessary for the provision of the energy service, and the energy service thus provided can achieve guaranteed energy savings.

According to the International Energy Agency (IEA) [17], in the search for optimal solutions aimed at increasing energy efficiency, it is necessary to focus on the field of technological innovation. Technological innovations create new opportunities for making progress in increasing energy efficiency. However, from the perspective of the implementation of innovative solutions into existing structures, it is necessary to use available solutions in the field of digitization. Digitization is beginning to have a significant impact on the energy sector and energy efficiency is emerging as a key element of innovation. It creates attractive new opportunities for integrated solutions, where efficiency and energy from renewable sources work together to achieve clean energy results at the lowest cost.

The paper aims to design a model for building energy management at the regional level using its own and external capacities. The contribution of the proposed model of optimizing the processes of energy management efficiency at the regional level is that it can also be applied to the supraregional level in the terms of the geographical division of the

European Union, where the same legislative regulations are applied within the liberalized electricity market.

2. Materials and Methods

Building energy management to implement an energy management system to increase energy efficiency requires an environment that has a clearly defined hierarchy of employees with clearly assigned competencies. If it is assumed that the built energy management should be an example of a good solution, then the basic set consists of employees under the founding authority of PSR. The main source of information from practice consists of data obtained by analysis of public administration employees in the Prešov region. The analysis of the PSR environment and the obtained results are published in the Analytical Study of Efficiency of the Energy Use in Facilities in the Establishment of the Prešov Self-Governing Region [18]. A total of 102 facilities employing 4201 employees were evaluated in the analytical study. Data collection was carried out by a questionnaire survey, while the results clearly showed the potential for increasing energy efficiency by more than 20%. The selection of the sample is justified, as the employees of PSR are directly affected by energy management and concern the performance of their profession. The present study demonstrates the potential for the introduction of energy-efficient measures to increase energy savings. Based on this fact and the need to build energy management in the PSR environment, a model of optimizing energy efficiency management processes was developed.

The research method was a questionnaire survey. The energy efficiency of electricity was determined using a questionnaire, which was focused on the area of electricity sources and was presented in the form of a self-assessment scale, while the initial version of the questionnaire contained 76 questions. It was possible to respond to individual items in the form of a statement of consent on a 5-point Likert scale (1—Strongly disagree, 2—Partially disagree, 3—Neither agree nor disagree, 4—Partially agree, and 5—Strongly agree). The research sample consists of employees of the Prešov self-governing region under the founding authority of PSK. The research sample consisted of 2350 respondents aged 21 to 79 years (mean age = 45.68, standard deviation = 11.521). Individual respondents were divided into three age groups concerning developmental periods [19], as each of the given developmental periods is characterized by specific work performance and the relationship to work itself. The respondents were categorized for a younger adult age: 21–35 years, there is a job integration; middle adult age: 35–50 years; and older adult age: over 51 years. The research sample consisted of 59.7% women and 40.3% men, with education in the fields of technical (38.6%), humanities (36%), science (17.8%), and other (7.7%), with 62.6% of respondents living in the city and 37.4% of respondents living in the countryside.

A one-way ANOVA and *t*-test were used to determine statistically significant differences in the assessed attributes of energy efficiency of electricity and age, education, residence, and type of housing of respondents. Pearson's correlation coefficient [20] was used to determine the statistically significant relationship between the assessed attributes of energy efficiency of electricity concerning the age of the respondents. Statistical analysis was performed in the program IBM SPSS 20.00.

3. Results

Based on theoretical background and analysis of the monitored environment, it can be concluded that energy efficiency management at the regional level can be understood as a professional background formed by a group of experts from own and external capacities, which introduces continuous improvement processes to increase energy efficiency and uses optimal conditions for the implementation of technical, technological, design, and construction solutions that determine the fulfillment of pre-explicitly defined objectives in comparison with the accepted reference level. The energy efficiency management presented in this way could be defined as the so-called energy management.

By analyzing the environment of the Prešov region under the administration of the Prešov self-governing region in cooperation with the support of expert groups in the regions defined by this area, a basic model of energy management was created, which is shown in Figure 1. By examining a specific environment, interactive relationships in energy management were addressed, while the research was based on the ability of the individual to be sensitive to energy management. Due to this fact, it was found that respondents differ in how they behave in the efficient management of electricity, and also in experiencing emotions in the process of efficient management of electricity, due to their field of education. Findings revealed that respondents who had a technical education in the emotional and behavioral attribute of energy efficiency scored higher than respondents with a humanities focus. Findings also showed that respondents living in the city and respondents living in the countryside do not differ in the level of energy efficiency of electricity. Based on a comparison of educational attainment, it was found that respondents with a university degree experience more positive and stronger emotions concerning efficient electricity management than respondents who have a vocational secondary education without a high school diploma. The research showed that respondents differ in thinking about how to save and efficiently manage electricity concerning whether they live in a family house, pay off a mortgage, live in a sublet, dormitory, or use another type of housing. A positive relationship between the age of respondents with the behavioral attribute of energy efficiency of electricity was found. Statistically significant differences were found between respondents aged 21 to 35 and respondents aged 36 to 50 in the level of the cognitive attribute in favor of respondents aged 36 to 50 years. At the level of the behavioral factor, statistically significant differences were found between respondents aged 21 to 35 years and respondents over 51 years, in favor of respondents over 51 years. In the level of the emotional attribute, statistically significant differences between respondents aged 36 to 50 years and respondents over 51 years in favor of respondents aged 36 to 50 years were found.

Based on the obtained results it can be stated that, from a psychological point of view, a suitable candidate for efficient electricity management is an employee aged 36 to 50 with a technical focus, with neither the place of residence nor the gender of the respondent being decisive. The role of energy management in the monitored area is to ensure the functioning of the system of efficient energy management. However, for energy management, as a group of skilled individuals, to be able to carry out the tasks set out in a coordinated manner, the organization must appoint a representative to whom it will delegate the relevant competencies and powers. The primary role of the nominated representative will be to inform the organization's top management of energy management, including matters affecting the operation of the entire energy management system. The representative should have managerial and communication skills, as well as professional knowledge, skills, and competencies in the field of energy, construction, informatics, and vocational training.

This representative (appointed by the top management) will build a management team that represents the top energy management (TEM). The role of the TEM is, through strategic management, to fulfill the set goals, taking into account all relevant facts. An integral part of the set tasks of TEM becomes the building and management of middle energy management (MEM), which is focused on tactical management. The synergy between TEM and MEM forms the basis of the energy management system under construction, and to implement its routine performance, it must build operational energy management (OEM). The performance of individual levels of management is based on the basic principle of energy management. OEM activity will be based on the principle of actual consumption, which is the energy needed to ensure the functionality of energy-related devices (energy for the computer, light, charger, etc.). The management of executive teams at the OEM level is based on measurement using gauges and will be influenced by changes in technical equipment, concerning the method of their maintenance or innovation. However, it is necessary to keep in mind that the OEM will prefer the principle of "consumed energy", i.e., the energy required to ensure the specified comfort (lighting regardless of presence in

the room, radio on regardless of listening, water heating regardless of the required amount, etc.). Therefore, the measurement of this energy will depend on the activities performed and the requirements will be set depending on the way the energy is used in real-time. The energy consumed in this way must be influenced by the OEM by the quality of use of energy equipment in real-time.

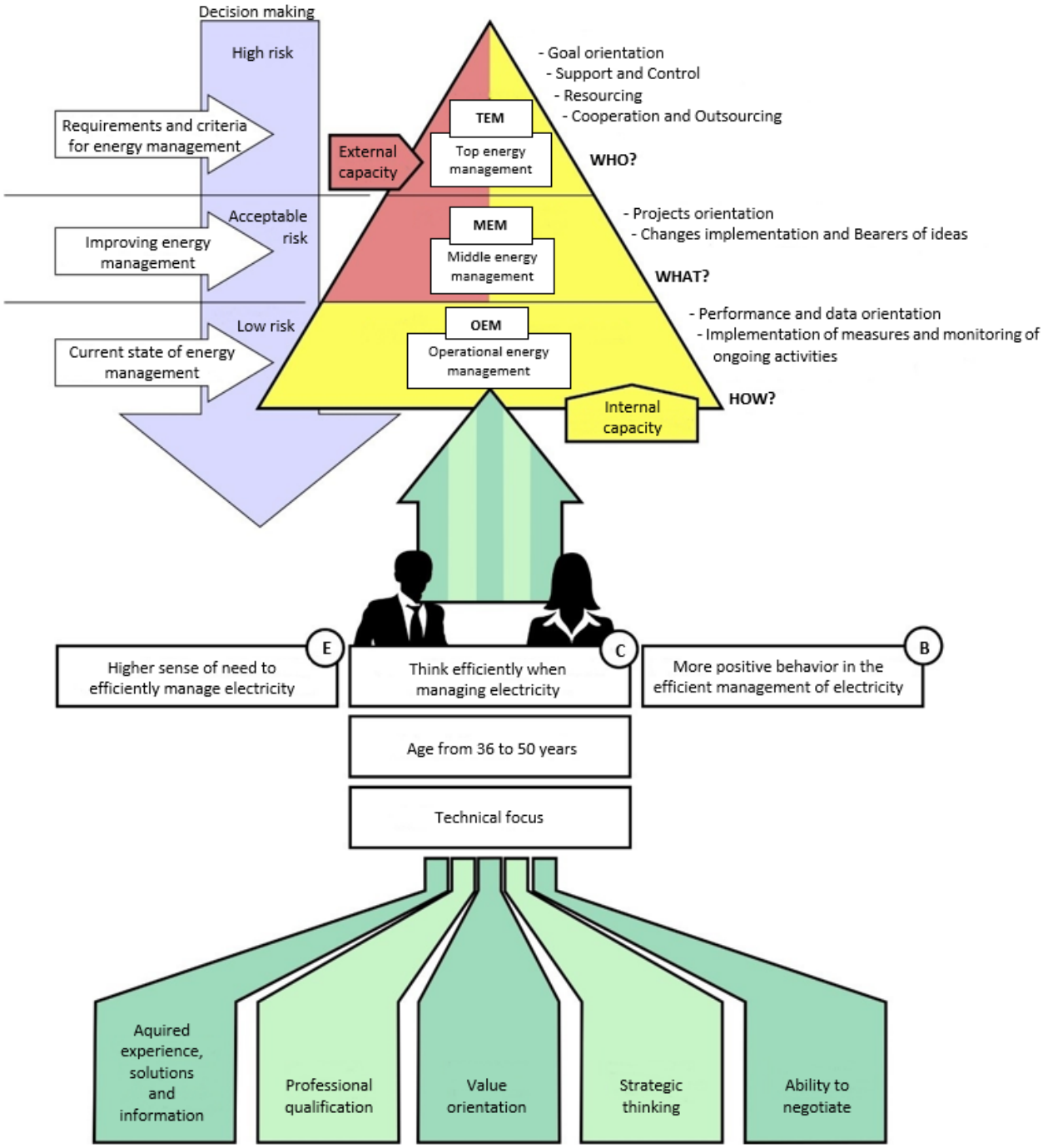

Figure 1. Design of a scheme for building energy management using own and external capacities.

Activity planning through energy management is to be provided by MEM. The individual plans in the organization are approved by TEM, setting out the energy policy and strategy for its implementation, including the scope of education. MEM plays an important role in building awareness of efficient energy management following energy policy, coordinating and being responsible for the implementation of all intentions at

various levels of management in horizontal and vertical interactions of complex energy management, as shown in the scheme (Figure 1).

4. Discussion

The energy manager in the management position, according to Kučera [4], does not have the task of defining the orders that will be executed, but above all coordinating cooperation with the involvement of individual members of energy management. From the point of view of energy management without its energy source, the "energy manager" is the person who is responsible for energy management, especially on the side of energy consumption, i.e., customers. According to Blažek [21], an energy manager should create the space for his co-workers for creative work, including participation in management, which is related to delegation, and must be able to lead his co-workers to be willing and able to use this space effectively via Motivation and especially coaching.

There are several studies focused on the energy management processes, such as Derakhshan [22], Ghiani et al. [23], Lin and Huang [24], Dzene et al. [25], Doukas et al. [26], Johansson et al. [27], Kwak et al. [28], Aznavi [29], Ndeke and Adonis [30], and Kurniawan [31]. Those studies point out the importance and the timeliness of the issue of energy management all over the world.

If we understand the phenomena that affect the way energy is managed, then we can build energy management that will maintain and improve the energy management system. The current introduction of information technologies and the existing requirement to decide on energies based on real data have identified the introduction of technical measurements in the data processing of the collected data as the focus of building energy management. The events that take place depending on the obtained data are perceived as a decision-making process in the structure of algorithms aimed at quantifying the units entering the building of the energy management system. From the point of view of supporting financing from Eurofunds, the implementation of technical changes, which takes the form of the implementation of new equipment and thermal insulation, has gained a dominant position in the field of increasing energy efficiency. Therefore, emphasis is currently placed on specific professions in the field of design, construction, audit, and construction, or technical changes in equipment specific to energy management.

5. Conclusions

This paper aimed to design a model of energy management of buildings at the regional level using its own and external capacities. For organizations to meet the requirements for increasing energy efficiency, it is necessary to build energy management from their capacities. Energy management can be built as a separate system or integrated into the existing environment of the quality management system, environmental management system, or own management system. If the organization decides to build energy management from its capacity then, based on the research, it can psychologically narrow the selection to employees aged 36 to 50 years with a technical focus.

A possible limitation of the research may be the fact that the search for the optimal solution in the field of optimization of energy management was carried out based on electricity management. The result, which appeared to be the most optimal in terms of long-term sustainability, was the building of energy management across the entire spectrum of energy used in the region. However, if the strategic goals in the field of increasing energy efficiency are to be met, then it is necessary to develop methodologies that will be based on the management of other types of energy. The challenge for future research is to develop a methodology that chooses non-energy profit as a basis and creates an evaluation process for energy management built in different regions.

Author Contributions: Conceptualization, M.R. and L.Š.; methodology, M.R., P.A. and A.T.; investigation, A.T., R.N. and M.B.; writing—original draft preparation, M.R., A.T. and L.Š.; writing—review and editing, M.R. and L.Š. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by project VEGA 1/0648/21 "Creation of a multicriteria model for evaluating the effectiveness of meeting the objectives of the Agenda 2030 program for the management of sustainable development". The contribution was also created thanks to the expert assistance of the Energy Cluster of Prešov Region and the financial support of the Environmental Energy Agency (Environmentálna energetická agentúra, n.o.).

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Dorokhova, M.; Ribeiro, F.; Barbosa, A.; Viana, J.; Soares, F.; Wyrsch, N. Real-World Implementation of an ICT-Based Platform to Promote Energy Efficiency. *Energies* **2021**, *14*, 2416. [CrossRef]
2. Soares, F.; Madureira, A.; Pages, A.; Barbosa, A.; Coelho, A.; Cassola, F.; Ribeiro, F.; Viana, J.; Andrade, J.; Dorokhova, M.; et al. FEEdBACk: An ICT-Based Platform to Increase Energy Efficiency through Buildings' Consumer Engagement. *Energies* **2021**, *14*, 1524. [CrossRef]
3. Jin-Zhao, A. Study on enterprise total management mechanism of energy conservation. *Agathos Int. Rev. Soc. Sci. Humanit.* **2013**, *4*, 99–107.
4. Kučera, M. About the substance of the conference/O vecnej náplni konferencie (In Slovak). Energy management 2018—Effective options for energy use. In Proceedings of the 4th Scientific Conference, Bratislava, Slovakia, 19–20 March 2018.
5. Gruber, J.K.; Prodanovic, M. Two-Stage Optimization for Building Energy Management. In *Smart Energy Control Systems for Sustainable Buildings, Smart Innovation, Systems and Technologies*; Littlewood, J., Ed.; Springer International Publishing: Cham, Switzerland, 2017; pp. 225–243.
6. Závadský, J.; Sakál, P.; Pomffyová, M.; Hrdinová, G.; Závadská, Z. *Management III*; Iura Ed.: Bratislava, Slovakia, 2012.
7. Huttmanová, E.; Adamišin, P. *Sustainable Development—Selected States and Problems/Udržateľný Rozvoj—Vybrané State a Problémy*; University of Prešov: Prešov, Slovakia, 2016. (In Slovak)
8. European Committee. Opinion of the European Economic and Social Committee on the 'Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, the Committee of the Regions and the European Investment Bank—Clean Energy for All Europeans'. Available online: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ:C:2017:246:TOC (accessed on 18 May 2021).
9. Vavrek, R.; Chovancová, J. Energy Performance of the European Union Countries in Terms of Reaching the European Energy Union Objectives. *Energy* **2020**, *13*, 5317.
10. Isoaho, K.; Moilanen, F.; Toikka, A. A Big Data View of the European Energy Union: Shifting from 'a Floating Signifier' to an Active Driver of Decarbonisation? *Politics Gov.* **2019**, *7*, 28–4410. [CrossRef]
11. Litavcová, E.; Chovancová, J. Economic Development, CO_2 Emissions and Energy Use Nexus-Evidence from the Danube Region Countries. *Energies* **2021**, *14*, 3165. [CrossRef]
12. Watson, R. *Future of 50 Ideas You Should Know/Budúcnosť 50 Myšlienok, Ktoré by Ste Mali Poznať*; Slovart: Bratislava, Slovakia, 2014. (In Slovak)
13. European Committee. Smart Cities and Communities–European Innovation Partnership. Available online: http://ec.europa.eu/eip/smartcities/files/ec_communication_scc.pdf (accessed on 18 May 2021).
14. Chudík, P.; Vinois, J.A. Partnership Agreement between the European Committee's Directorate-General for Energy and the Prešov Region—Convention of Mayors in the Prešov Region/Dohoda O Partnerstve Medzi Generálnym Riaditeľstvom Pre Energetiku Európskej Komisie a Prešovským Samosprávnym Krajom—Dohovor Primátorov a Starostov v Prešovskom Kraji (In Slovak). Available online: https://www.po-kraj.sk/files/dokumenty-Brusel/dohoda_primatorov_starostov_sk_verzia_web.pdf (accessed on 18 May 2021).
15. Fitzeková, V. ELENA Enable to Increase of Energy Efficiency/ELENA Umožní Zvýšiť Energetickú Efektívnosť (In Slovak). Available online: https://www.po-kraj.sk/sk/samosprava/aktuality/aktuality-2015/elena-umozni-zvysit-energeticku-efektivnost.html (accessed on 18 May 2021).
16. Act no. 321/2014 Coll., Act on Energy Efficiency and on Amendments to Certain Acts. Available online: https://www.zakonypreludi.sk/zz/2014-321 (accessed on 18 May 2021).
17. IEA (International Energy Agency). Global energy trends to 2035. In *World Energy Outlook*; IEA Publications: Paris, France, 2013; pp. 55–98.
18. Tokarčík, A.; Rovňák, M. *Analytical Study of Efficiency in the Use of Energy in Facilities in the Founding Competence of the Prešov Self—Governing Region/Analytická Štúdia Efektívnosti Pri Používaní Energií v Zariadeniach v Zriaďovateľskej Pôsobnosti Prešovského Samosprávneho kraja*; Prešov Self-Governing Region: Prešov, Slovakia, 2015. (In Slovak)
19. Drlíková, E. *Učiteľská Psychológia*; SPN: Bratislava, Slovakia, 1992.
20. Hendl, J. *Přehled Statistických Metód. Analýza a Meta Analýza Dát*; Portál: Praha, Czech Republic, 2012.
21. Blažek, L. *Management Organizování, Rozhodování, Ovlivňování*, 2nd ed.; Grada Publishing: Praha, Czech Republic, 2014.
22. Derakhshan, R. Establishment of the energy management system in Tehran municipality district 7. *Iran. J. Energy* **2015**, *18*, 1–22.
23. Ghiani, E.; Giordano, A.; Nieddu, A.; Rosetti, L.; Pilo, F. Planning of a smart local energy community: The case of Berchidda municipality (Italy). *Energies* **2019**, *12*, 4629. [CrossRef]

24. Lin, Q.G.; Huang, G.H. Planning of energy system management and GHG-emission control in the Municipality of Beijing—An inexact-dynamic stochastic programming model. *Energy Policy* **2009**, *37*, 4463–4473. [CrossRef]
25. Dzene, I.; Polikarpova, I.; Zogla, L.; Rosa, M. Application of ISO 50001 for implementation of sustainable energy action plans. *Energy Procedia* **2015**, *72*, 111–118. [CrossRef]
26. Doukas, H.; Patlitzianas, K.D.; Iatropoulos, K.; Psarras, J. Intelligent building energy management system using rule sets. *Build. Environ.* **2007**, *42*, 3562–3569. [CrossRef]
27. Johansson, I.; Mardan, N.; Cornelis, E.; Kimura, O.; Tholander, P. Designing Policies and Programmes for Improved Energy Efficiency in Industrial SMEs. *Energies* **2019**, *12*, 1338. [CrossRef]
28. Kwak, Y.; Shin, S.; Oh, S.; Kwon, O.; Lee, D. Development of South Korea's National Integrated Building Energy Management System for Green Building Policies: Overview and Building Energy Statistics. In Proceedings of the 15th IBPSA Conference, San Francisco, CA, USA, 7–9 August 2017.
29. Aznavi, S. Intelligent and Cost-Effective Energy Management of Smart Building Equipped with behind the Meter Energy Storage Systems. Ph.D. Thesis, University of Nevada, Reno, NV, USA, 2020.
30. Ndeke, C.; Adonis, M. Energy Efficiency and Energy Management in South Africa—Standards, Barriers and Policies. In Proceedings of the AIUE 18th Industrial and Commercial Use of Energy Conference, Cape Town, South Africa, 23–27 November 2020.
31. Kurniawan, R. Assessing the Implementation of the Energy Management System in the First ISO 50001 Building in Indonesia. *Indones. J. Energy* **2021**, *4*, 129–139. [CrossRef]