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INVESTIGATING THE EFFICIENCY IMPROVEMENT POSSIBILITIES OF SOLAR SYSTEMS USING SYSTEMATIC LITERATURE RESEARCH

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Abstract: *Today's energy-demanding industrial and residential environment, in view of future challenges, requires more efficient energy production, distribution and network development methods than ever before. In relation to the area, it became necessary to develop new system models and optimization methods, by applying which the planning, installation, logistics, operation and maintenance efficiency of the examined systems can be significantly increased. The important objective of the publication is to analyze and summarize the scientific results found so far on the topic, as well as to identify the scientific gap based on the obtained results.*

Keywords: *solar systems, logistics, energy community, optimization*

1. INTRODUCTION [1], [2], [3], [38]

The solar market in recent years was characterized by significant growth and excess demand until October 2022. State subsidies and green energy initiatives in Hungary had an encouraging effect on the installation of solar systems. Subsequently, due to changes in the legal and economic environment, a significant decrease in demand was observed at the household level. In parallel, due to the increase in energy prices in recent years, there has been a significant demand in the industrial and small and medium-sized enterprise sectors for solutions for the partial or full production of the energy required for operation.

In the case of an industrial facility, traditional energy consumption is significantly related to the time schedule of production planning, logistics, service, and further operational processes. Their organizational typology is fundamentally based on the continuity of energy supply, based on the use of an energy quantity contracted with the service provider per unit of time.

Considering the high rate of energy price increase after 2020, after the development of its own energy production options, it will be worthwhile to flexibly coordinate the scheduling of the above-mentioned operational processes with the capacities of independent energy production.

When examining a single-player unit equipped for partial or complete energy self-sufficiency, several parameters can influence the possibilities of energy self-sufficiency. These can be physical, material, or other parameters that can be modified to a limited extent in the case of a single player. Therefore, to increase flexibility, it is worth examining multi-player systems or system models, which, by cooperating in some kind of energy community, are able to strengthen each other's capabilities and, by coordinating their systems, optimize their energy capacities from both an energy production and consumption perspective.

Thanks to the extremely large amount of data collected by organizations using Industry 4.0 tools, it will be possible to plan not only with historical data, but also to make predictions

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using machine learning methods and artificial intelligence, which will provide the basis for the creation of energy communities that are constantly learning and developing and can flexibly adapt to circumstances.

A review of the available literature makes it obvious that in response to future energy challenges, the further development of solar systems in both the residential and industrial sectors, as well as the implementation of new alternative utilization of solar energy, is inevitable.

2. SYSTEMATIC LITERATURE RESEARCH [1], [2], [3], [37]

The systematic literature review methodology includes searching for relevant scientific publications on a given topic, their organization, and analysis according to a system of criteria. The aim of the literature analysis is the transparent scientific presentation of the examined topic while maintaining complete objectivity. Systematic literature research is a scientific investigation that requires prior planning and strict application of the method. The analysis also covers the search for specialist literature in English and Hungarian. In addition, I tried to use the most effective methods appropriate to the age, so I could not ignore the use of artificial intelligence.

However, it is important to note that I used artificial intelligence solely to maximize research efficiency, so that scientific publications that I may not have found remained hidden. Thus, I used it as a secondary tool to strengthen objectivity even more.

However, the summary of the research results, as well as the conclusions and further activities derived from them, were carried out based on my own thoughts. So I used artificial intelligence as a tool, not as a replacement for the work to be done. In the following, the steps of systematic literature research are described.

2.1. Definition of motivation

The current research aims to analyze the further possibilities of solar systems in the industrial and residential segments with appropriate professionalism and to explore new solutions to solve the energy challenges of the future.

2.2. Formulation of research questions

What scientific research has been published in this area since 2020?
What research areas relevant to the topic are they investigating?
Which areas have not been studied from a scientific point of view?
What changes can occur as a result of the research results?

2.3. Defining keywords

The purpose of this part is to define the topics and define the keywords within them in Hungarian and English. The scientific theses were examined with the relationship between any keywords. The keywords are:

- Energy communities from a logistical aspect:
  a) energy community - energy community
  b) logistics - logistics

   c) optimization
   d) Industry 4.0 - Industry 4.0
- Solar systems supply chain:
   a) logistics - logistics
   b) solar system - solar system
   c) supply chain - supply chain
   d) optimization
   e) industry 4.0 - industry 4.0

The analysis of the available literature is based on the two databases available and the basis of the research: Scopus and Google Scholar. During the analysis, the period up to 2020-2024 was reviewed.

2.4. Brief presentation of the literature research method [3]

With the traditional method of literature research, due to the complexity of the topic, an extremely large number of hits was generated when one keyword was used in combination with "and", therefore, by further increasing the keywords, it was possible to narrow the list of hits.

A total of 24 articles can be found between 2020 and 2024 using the search terms used (solar AND energy AND community AND logistics).

To be thorough during the research I did not rely on a database. Therefore, with the previously defined keywords, I also performed a search in Google Scholar, among the 17,200 results of which, based on a relevance-based search, I looked at the best 50 articles in Google Scholar, of which the analysis of 9 relevant articles is summarized in the table.

The Scopus database by filling out the interface as intended. Based on the topics defined above and the keywords, I performed the searches in the Scopus database, the results of which are shown in the table below.

Table I/a.

Summary evaluation of relevant literature data

Source	The number of investigated energy communities	The geographical area under investigation	Software tracking	Calculation methods	Renewable energy sources and their ratio	Energy policy and support system	Consumption forecast
[4]	10 households in Quaqtaq village	Quaqtaq, Nunavik, Canada	No software defined	Not specified	Solar irradiance analysis	-	-
[5]	-	Netherlands	No software defined	Not specified	Solar panel adoption	Yes	-
[6]	-	Connecticut, USA	Logarithmic growth function	Not specified	Roof top solar	Yes	-
[7]	4 SWPS projects	Indonesia	No software defined	Not specified	Solar water-pumping	-	-

Table I/b.

Summary evaluation of relevant literature data

Source	The number of investigated energy communities	The geographical area under investigation	Software tracking	Calculation methods	Renewable energy sources and their ratio	Energy policy and support system	Consumption forecast
[8]	-	Australia	No software defined	Not specified	Roof top solar, service protection	Yes	-
[9]	-	Temperate, boreal and arctic ecosystems	No software defined	Distance sampling	-	-	-
[10]	-	Kakoba , Uganda	No software defined	Not specified	-	-	-
[11]	-	India	No software defined	Not specified	Solar energy, wind energy	Yes	-
[12]	-	West Coast, USA and Canada	No software defined	Not specified	Wave energy	-	-
[13]	649 residential area Ibadan	Ibadan , Nigeria	No software defined	Not specified	Solar panels	Yes	-
[14]	-	Verkhoyansk, Russia	No software defined	Economic analysis	Solar energy, diesel	-	Indirect
[15]	-	Huntsville , USA	No software defined	Solar system design	Solar energy	Yes	-
[16]	Island communities	Island communities	HOMER software	Cost estimation methods	Solar energy, wind energy	-	Indirect
[17]	-	Pakistan	No software defined	Not specified	Solar panels	-	-
[18]	Arctic communities	Nunavut , Canada	No software defined	Energy and exergy analysis	Solar energy, ocean thermal energy	-	-
[19]	-	Moon	No software defined	Not specified	-	-	-
[20]	-	Not relevant	Convolutional neural network	Ensemble model	-	-	-
[21]	-	Oromia , Amhara and Southern Nations, Ethiopia	Atlas.ti analysis	No software defined	-	-	-
[22]	-	Connecticut, USA	Logarithmic growth function	Logarithmi c growth function	Roof top solar	Yes	-
[23]	-	North Central Nigeria	No software defined	Not specified	Solar energy	Yes	-
[24]	-	Pakistan	No software defined	Not specified	Solar panels	Yes	-
[25]	-	Not specific	No software defined	Not specified	Solar energy	Not	-

Table I/c.

Summary evaluation of relevant literature data

Source	The number of investigated energy communities	The geographical area under investigation	Software tracking	Calculation methods	Renewable energy sources and their ratio	Energy policy and support system	Consumption forecast
[26]	-	Remote locations	No software defined	Areal power density	Solar energy	-	-
[27]	-	Ghana	No software defined	Not specified	Solar energy	-	-
[28]	-	Australia	No software defined	Not specified	Solar energy	-	-
[29]	-	Cochrane, Ontario Canada	PVSyst - Solar system design software System Advisor Model (SAM) - For wind energy system analysis	Thermo-dynamic analysis, time-dependent simulation, economic analysis	Solar energy, wind energy	-	Yes
[30]	-	Ukraine	No software defined	Economic analysis, Energy logistics	Solar energy, biomass	Yes	-
[31]	-	USA	No software defined	Social acceptance analysis, interview-based research	Solar energy (agrivoltaic system)	Yes	-
[32]	1	Indonesia	HOMER	Technical-economic evaluation, Sensitivity analysis	Solar energy, wind energy, biomass	Yes	Yes
[33]	-	Malawi	No software defined	Sustain-ability framework	Solar energy	-	-
[34]	1	Columbia	No software defined	Green logistics analysis	Solar energy, wind energy	Yes	Yes
[35]	1	Canada, Ontario	System Advisor Model (SAM)	Energy and exergy analysis	Wind energy, concentrated solar energy	-	-
[36]	-	Not specified	No software defined	Mathemati-cal modeling, Optimiza-tion algorithms	Solar energy, wind energy, biomass, sector connection	Yes	Yes

2.5. Systematic literature analysis [4], [5], [6]

After selecting and reading relevant publications according to the criteria defined earlier, the focus is on defining the main research direction. During the systematic literature research, the areas of expertise are narrowed down based on the research area and the language. During the current research publications were selected that corresponded to the following areas: research article, review article, literature article, book chapter, mini-review. In the case of a topic or question that arose during the analysis of some literature, new sources were found by searching for additional sources. e.g.: [38].

During the study of the abstracts of the articles, the following aspects were taken into account:

- The number of energy communities investigated
- The geographical area under investigation
- Software tracking
- Calculation methods
- Community Energy System Planning (CESP)
- Renewable energy sources and their ratio
- Energy storage solutions
- Energy policy and support system
- Consumption forecast

More important findings:

- To cover or supplement local energy needs with different renewable energy sources or their combination.
- Research on this has been carried out in several countries of the world, including the United States, Nigeria, Pakistan, and Hungary. There is an article that does not examine the method of energy production, but the aspects of energy consumption related to consumer habits (Cavalerie et al.) [4].
- Another study in [16] Lopez-Castrill at al. deals with the analysis of an island community model operating in an isolated system in the Chilean archipelago, where the traditional electrical network built using deep-sea cables common in other parts of the world is inaccessible to a small number of users.
- Little data was found in terms of software monitoring. One of the articles: [16] Lopez-Castrill at al. examines the Huichas - island community, which with its 840 inhabitants is a relatively manageable size energy community. This community currently supplies its energy from a diesel-based energy source with a so-called renewable hybrid energy system. Hybrid Renewable Energy System (HRES) At several points, the study mentions the models made using the HOMER software, which investigates the possibility of integrating different energy sources, such as diesel, solar energy, wind energy, and energy storage solutions, such as lithium-ion batteries. In another article [36] Temiz etal. mention PVSyst - software, as well as the System Advisor Model (SAM), which was used for similar analyses in several cases.
- In the examined literature, I did not find a clear description of calculation methods that could be specifically adapted for the purpose of planning and operating energy communities in Hungary. However, based on the information learned, it can

generally be said that certain factors are important to keep in mind when creating such a method.

- One of these factors is the LCOE (Levelized Cost of Energy) which shows the average cost of producing a unit of energy over the entire life cycle, taking into account the total costs (investment, maintenance, maintenance, and other costs). Another such factor is NPC (Net Present Cost), which measures the total costs of the long-term project. Cost optimization models are another such aspect, which helps to determine the most optimal cost structure, taking into account investment, operating and other costs.
- Several of the studied studies deal with the planning of energy communities based on the production and use of renewable energy, [11]-[36] but the relevant literature tries to establish sustainability with the possibility of combining different renewable energy sources and tries to realize their combined production calculation according to some criteria system, with which they try to determine the size of a system capable of partial or full coverage of all energy requirements.
- A specific planning methodology can be transferred to other energy communities, which is based on a procedure that deeply analyzes and evaluates the consumption profile of individual participants in the energy communities.
- Based on the examined abstracts, it cannot be stated that a list of the optimal combination of different renewable energy sources was established in a geographically specified manner. In general, however, it can be stated that solar energy appears as a dominant energy source in those regions where the number of hours of sunshine is high on an annual basis. Where wind energy can be used with variable intensity, but the number of daylight hours is fewer, the joint use of these two energy sources can be a solution. Wave energy cannot be left out of the list of renewable energy sources either, which can be obtained by using the kinetic energy of waves generated on the surface of oceans and seas. There are several solutions for this energy production method, but these can be used in places where wave energy is constantly present, e.g.: Japan, Australia, or the coastal regions of Northern Europe. From the point of view of Hungarian energy communities, this energy source is not important. However, what should be included in the list as an alternative worthy of mention are biogas power plants [38]. This represents a solution for energy production that can be used with good efficiency in agriculturally active areas and in industries that generate a lot of organic waste. One advantage of biogas power plants is that they provide continuous, stable energy production, which complements the variability of solar or wind power plants. As the last element of the list of renewable energy sources in this article, I mention geothermal energy, which is also a reliable energy source. Hungary's geothermal properties are favorable, there is a significant amount of heat in the deeper layers of the Carpathian Basin. However, to produce electricity, geothermal energy can be a significant player in an energy community based on combined energy sources in the case of high-temperature geothermal sources. Thus, its possibilities of use are relatively limited geographically even within the country
- From the point of view of energy storage solutions the analyzed articles contain several approaches to the energy storage possibilities of energy communities. In general, however, it can be said that when focusing on one renewable energy source, such as solar energy, the variability of energy production cannot be ignored.

The effective use of this can be improved by a certain level of reorganization of usage habits, but it is not practical to follow it completely. Therefore, it is worth looking for an opportunity to regroup the energy produced but not used in a given period in some way, for which the use of energy storage can be a solution.

- Energy policy and support solutions play a prominent role in the spread of renewable energy sources and in stimulating the willingness to invest. But all international sources of information discussing this topic point to the fact that social sensitivity to the topic, as well as political support for the given technical solution, greatly influence the spread of these technologies.
- Consumption forecasting, as a basis for planning energy communities, is still an immature field. There are many attempts, experiments, and simulations [36], which prepare consumption profile-based analyses taking into account the characteristics of a given geographical area. The results of these will be worth taking into account in the future, in the case of planning local systems with a small number of employees. Since the determination of the energy consumption profile for the found articles [32] is made using general consumption profiles and local parameters, it is worthwhile to think about these further and implement the development of a procedure that can be applied in Hungary.

3. Summary - Defining the research "GAP"

Currently, one can be found among the research literature that deals with energy communities, but there is no one in which the designation of actors of energy communities is determined based on the analysis of their consumption habits. In all cases, the scientific theses discuss the design and operation of an energy production system or systems created for alternative satisfaction of the energy needs of a previously existing community. No literature has been uncovered in which, based on some kind of consumption forecast or consumption planning, actors are selected from a given area, even from different market segments, to create a system operating as a small local energy community based on a solar panel system and energy storage. In the future, after processing the literature analysis, we plan to develop the topic of a specific scientific niche, as well as to implement it in practice.

References

[1] https://www.scopus.com/

[2] https://scholar.google.com/

[3] https://chat.openai.com

[4] Cavalerie , A. & Gosselin , L. (2024). Analysis of windows opening in arctic community housing and development of data-driven models. *Building and Environment*, **258**, 111582, https://doi.org/10.1016/j.buildenv.2024.111582

[5] Akhatova, A., Derkenbaeva, E., van Leeuwen, E., Halleck Vega, S. & Hofstede, G.J. (2024). Who invest in energy retrofits? Mining Dutch homeowners ' data. *Energy Policy,* **189**, 114132, https://doi.org/10.1016/j.enpol.2024.114132

[6] Holt, E.G. & Sunter, D.A. (2024). Growth in energy justice: Exploring impacts of Residential Solar Incentive Program on rooftop solar adoption growth rates in Connecticut. *Energy Research & Social Science*, **109**, 103410, https://doi.org/10.1016/j.erss.2024.103410

[7] Rahmani, S., Murayama, T., Nishikizawa, S. & Suwanteep, K. (2024). Assessing the post-construction support for solar water-pumping systems in rural areas communities in Indonesia. *Environ. Dev. Sustain,* **2024**, https://doi.org/10.1007/s10668-024-04981-z

[8] White, L.V., Riley, B., Wilson, S., Klerck, M. & Davis, V.N. (2024). Geographies of regulation disparity underlying Australia's energy transition. *Nat Energy* **9**, 92–105, https://doi.org/10.1038/s41560-023-01422-5

[9] DeWitt, P.D. & Cocksedge, A.G. (2023). The simple framework for maximizing camera trap detections using experimental trials. *Environ Monit Assess,* **195**, 1381, https://doi.org/10.1007/s10661-023-11945-9

[10] Martin, T., Nanjebe, D. & Atwine, D. (2023). Assessment of the proportion of households with burn victims , associated risk factors and knowledge of burn injury prevention strategies in South Western Uganda. *A population based cross sectional survey.* Burns. **49**(7), 1756-1764. https://doi.org/10.1016/j.burns.2023.03.016.

[11] Sharma, A., Hemanth, P.B., Bhavani, A. & Dixit, A.C. (2023). Green Hydrogen for Sustainable Future: Prospects and Challenges for Energy-Based Applications in Major Indian States by 2030. *E3S Web of Conf.,* **405,** 02027, https://doi.org/10.1051/e3sconf/202340502027

[12] Stelmach, G., Hazboun, S., Brandt, D. & Boudet, H. (2023). Public perceptions of wave energy development tin the west coast of North America: Risks, benefits, and coastal attachment. *Ocean & Coastal Management,* **241**, 106666, https://doi.org/10.1016/j.ocecoaman.2023.106666

[13] Adewole, A., Shipworth, M., Lemaire, X. & Sanderson, D. (2023). Peer -to -Peer energy trading, independence aspirations and finances benefits among Nigerian households. *Energy Policy,* **174**, 113442, https://doi.org/10.1016/j.enpol.2023.113442

[14] Badamshina, S., Klokov, A. & Loktionov, E. (2023). Opportunities for Economic Efficiency Increase in renewables Energy Powered Off-Grid Systems. *2023 International Ural Conference on Electrical Power Engineering (UralCon),* Magnitogorsk, Russian Federation, 583-588, https://doi.org/10.1109/UralCon59258.2023.10291053

[15] Pecen, R.R. & Yildiz, F. (2022). Design and Construction of a 50 kW PV- based EV Fast-Charging Station as a community engagement project. *2022 ASEE Annual Conference & Exposition*, 37956, https://doi.org/10.18260/1-2--41708

[16] López- Castrillón, W., Sepúlveda, H.H. & Mattar, C. (2022). Too many solar panels ? Oversizing guard undersizing of hybrid renewable energy systems based tin different sources of information. *Sustainable Energy Technologies and Assessments*, **52**, Part C, 102264, https://doi.org/10.1016/j.seta.2022.102264

[17] Ahmar, M., Ali, F., Jiang, Y., Wang, Y.& Iqbal, K. (2022). Determinants of Adoption and the Type of Solar PV Technology Adopted in Rural Pakistan. *Front. Environ. Sci., Sec. Environmental Economics & Management,* **10**, https://doi.org/10.3389/fenvs.2022.895622

[18] Temiz, M. & Dincer, I. (2022). The unique ocean and solar based multigenerational system with hydrogen production and thermal energy storage for Arctic communities. *Energy*. **239**, Part B, 122126, https://doi.org/10.1016/j.energy.2021.122126

[19] Landgraf, M., Reynolds, J., Barbier, F.-X., Duvet, L. & Magistrati, G. (2024). ESA's Future Moon Mission Studies. *Proceedings of the International Astronautical Congress*, ISSN 00741795

[20] Chen, J., Li, W., Li, S., Chen, Y. & Deng, H. (2022). Two-Stage Solar Flare Forecasting Base tin Convolutional Neural Networks. *Space: Science & Technology*. **2022**, 9761567, https://doi.org/10.34133/2022/9761567

[21] Higi, A.H., Debelew, G.T. & Dadi, L.S. (2021). Perception and experience of health extension workers tin facilitators and barriers lake maternal and newborn health service utilization in Ethiopia: A qualitative study. *Int. J. Environ. Res. Public Health*, **18**(19), 10467; https://doi.org/10.3390/ijerph181910467

[22] Holt, E. & Sunter, D.A. (2021). Historical Patterns for Roof top Solar Adoption Growth Rates in Connecticut. *IEEE 48th Photovoltaic Specialists Conference* (PVSC), Fort Lauderdale, FL, USA, 1610-1613, https://doi.org/10.1109/PVSC43889.2021.9518878

[23] Okwanya, I., Alhassan, A., Migap, J.P. & Adeka Sunday, S. (2020). Evaluating renewable energy choices among rural communities in Nigeria . An insight for energy policy. *International Journal of Energy Sector Management.* **15**(1), 9. https://doi.org/10.1108/IJESM-12-2019-0001

[24] Jan, I., Ullah, W. & Ashfaq , M. (2020). Social acceptability of solar photovoltaic system in Pakistan: Key determinants and policy implications. *Journal of Cleaner Production*, **274**, 123140, https://doi.org/10.1016/j.jclepro.2020.123140

[25] Chen, H. (2020). Design of a small logistics robot system based tin solar energy. E3S Web Conf. **204**, 02001, https://doi.org/10.1051/e3sconf/202020402001

[26] Thomsen, N., Papazoglou, D., Wagner, T., Hoisington, A. & Schuldt, S. (2020). A Multi-Criteria Logistics Analysis of Photovoltaic Modules for Remote Applications. *47th IEEE Photovoltaic Specialists Conference* (PVSC), Calgary, AB, Canada, 0544-0548, https://doi.org/10.1109/PVSC45281.2020.9300756

[27] Deal, P. & Sabatini, D. (2020). Evaluating the level of the household water service provided by a private water enterprise in Ghana. *Water*, **12**(3), 693, https://doi.org/10.3390/w12030693

[28] Li, X., Chang, R., Zuo, J. & Zhang, Y. (2023). How does residential solar PV system diffusion occur in Australia? - A logistic growth curve modeling approach. *Sustainable Energy Technologies and Assessments*. **56**, 103060, https://doi.org/10.1016/j.seta.2023.103060

[29] Temiz, M., Dincer, I. (2022). Development of solar and wind based hydrogen energy systems for sustainable communities. *Energy Conversion and Management*. **269**, 116090, https://doi.org/10.1016/j.enconman.2022.116090

[30] Koval et under (2019). Environmental Concept of Energy Security Solutions of Local Communities Base tin Energy Logistics. *International Multidisciplinary Scientific GeoConference-SGEM*, **19**(5.3), https://doi.org/10.5593/sgem2019/5.3/S21.036

[31] Pascaris, A.S., Schelly, C., Burnham, L. & Pearce, J.M. (2021). Integrating Solar Energy with Agriculture : Industry Perspectives tin the Market, Community , and Socio-political Dimensions of Agrivoltaics. *Energy Research & Social Science*, **75**, 102023, https://doi.org/10.1016/j.erss.2021.102023

[32] Pandyaswargo, A.H., Wibowo, A.D. & Onoda, H. (2022). Socio -techno- economic assessment to design an appropriate renewable energy system for remote agricultural communities in development countries. *Sustainable Production and Consumption*, **31**, 492-511, https://doi.org/10.1016/j.spc.2022.03.009

[33] Dauenhauer, P.M., Frame, D., Eales, A., Strachan, S., Galloway, S. & Buckland, H. (2020). Sustainability Evaluation of Community-Based Solar Photovoltaic Projects in Malawi. *Energy, Sustainability and Society*, **10**, 12, https://doi.org/10.1186/s13705-020-0241-0

[34] Diaz, L., Ramirez, L. & Fabregas, J. (2021). Green Logistics in Off-Grid Renewable Energy Projects for Rural Localities. *International Journal on "Technical and Physical Problems of Engineering"* (IJTPE), **13**(3), 119-124.

[35] Temiz, M. & Dincer, I. (2022). Development and Assessment of an Onshore Wind and Concentrated Solar Base Power , Heat , Cooling , and Hydrogen Energy System for Remote Communities. *J. of Cleaner Prod.*, **374**, 134067, https://doi.org/10.1016/j.jclepro.2022.134067

[36] Barabino et al. (2023). Energy Communities : A Review tin Trends , Energy System Modelling, Business Models , and Optimization Objectives. *Sustainable Energy, Grids and Networks*, **36**, 101187, https://doi.org/10.1016/j.segan.2023.101187

[37] Matyi, H. & Tamás, P. (2023). An Innovative Framework for Quality Assurance in Logistics Packaging. *Logistics*, **7**(4), 82, https://doi.org/10.3390/logistics7040082

[38] Toldi, O. & Bera, P. (2022). *A biogáz-termelés helyzete és jövője Magyarországon – szakpolitikai elemzés*. Retrieved from https://klimapolitikaiintezet.hu/elemzes/biogaz-termeles-magyarorszag-szakpolitikai-elemzes