Chapter 10
Analysis of Existing Approaches to Energy Efficiency Management at the Strategic Level

Solomon Eghosa Uhunamure and Tsangyao Chang

Keywords Development · Ecosystem · Economic growth · Energy technologies · Clean energy

10.1 Introduction

Energy analysis is an analytical part of the process of planning energy saving activities and is based on assessing the actual amount of resources consumed, identifying the reasons for deviations from planned values, identifying losses, and determining the potential for reducing energy consumption. This section regulates the procedure for accounting for the most significant objects of resource consumption and the use of this information when forming a balance of energy consumption.

The energy baseline as an important stage of strategic planning of energy consumption is used for comparison with the actual values of energy efficiency indicators in relation to the planned indicators. When compiling the analysis report, the energy baselines established for both significant technological processes for the reporting period and for the calendar year following the reporting period are used (Xu et al., 2022; Bhuiyan et al., 2022; Kou et al., 2022; Ermiş & Güven, 2022). Energy resources that are spent on the technological process and depend on the volume of production will be subject to rationing. Resources that are consumed due to the needs of production support systems and do not have a pronounced dependence on the production process are subject to limitation.

Evaluation of technical measures implemented at the metallurgical enterprise. The main directions of implementation of the strategy for modernization of the

S. E. Uhunamure (✉)
Cape Peninsula University of Technology, Cape Town, South Africa
e-mail: uhunamures@cput.ac.za

T. Chang
Feng Chia University, Taichung City, Taiwan
e-mail: tychang@fcu.edu.tw

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plant's energy infrastructure facilities in the period from 2017 to 2021 were the introduction of measures in the field of consumption of electric and thermal energy, natural gas and water. The total amount of investment for the implementation of the measures amounted to about 300 million rubles, with an average payback period of 4.5 months.

10.2 Literature Review

An integrated analysis of activities in the period from 2017 to 2020 confirms that the main direction of energy saving is the optimization of technological processes in production. At the same time, investment in energy sector modernization projects is carried out on an irregular basis, and preference is given to projects that have a high degree of development (Nie et al., 2020; Denisova et al., 2019; Nyangarika et al., 2019b; Nyangarika et al., 2019a; Huang et al., 2021a; Huang et al., 2021b; Mikhaylov, 2018; Mikhaylov et al., 2019; Conteh et al., 2021; Mikhaylov, 2022a; Sediqi et al., 2022; Khan et al., 2021; Bhuiyan et al., 2022a; Liu et al., 2021a, 2021b; Daniali et al., 2021; Moiseev et al., 2023; An et al., 2022).

Significant reserves of energy saving are associated with the operation of pipe rolling and electric steelmaking shops. When performing energy analysis, the following areas can be distinguished: electricity and gas consumption in ensuring technological processes for the production of pipe billets and pipes. Also, the steam production site with morally and physically obsolete equipment has a huge potential for energy saving (Mikhaylov et al., 2022c; Mikhaylov, 2021a; Varyash et al., 2020; Zhao et al., 2021; An & Mikhaylov, 2020; Alwaelya et al., 2021; Yumashev & Mikhaylov, 2020; Yumashev et al., 2020; Mutalimov et al., 2021; An & Mikhaylov, 2021).

As recommendations aimed at improving the energy efficiency management system, it is proposed to improve the work of the enterprise in terms of motivating personnel and developing processes for informing and promoting energy conservation at all levels of management. To assess the effectiveness of achieving energy saving indicators, it is necessary to create an internal information system for storing and processing energy consumption data (Dayong et al., 2020; Nyangarika et al., 2018; Danish et al., 2020; Danish et al., 2021; An et al., 2021; Uyeh et al., 2021; Tamashiro et al., 2021; Tamashiro et al., 2023; Shaikh et al., 2021).

Another important step in optimizing the energy efficiency management mechanism is the procedure for distributing responsibility between system participants (An et al., 2019a, 2019b; Mikhaylov & Tarakanov, 2020; An et al., 2020b, 2020a; An et al., 2020c; Moiseev et al., 2020; Moiseev et al., 2021; Gura et al., 2022; Dooyum et al., 2020; Mikhaylov et al., 2020; Mikhaylov, 2020a; Mikhaylov, 2020b; Mikhaylov, 2020c).

10.3 Development of an Algorithm for Making Investment Decisions when Implementation of Energy Saving Projects

Based on the theoretical and practical research conducted in the previous chapters, it can be concluded that due to the increasing competition in the metallurgical industry, the key area that has a huge potential for optimization is improving energy efficiency. Moreover, both technological innovations and organizational changes serve as tools for implementing improvements. The importance of improving energy efficiency for metallurgical enterprises is increasing, which in turn leads to a rethinking of energy sector development strategies (Khan et al., 2022; Dinçer et al., 2022b, 2022d; Badr et al., 2022; Barykin et al., 2022a; Mehta et al., 2022; Kalinina et al., 2022; Shaikh et al., 2022; Mikhaylov et al., 2022; Nyangarika et al., 2022; Mikhaylov et al., 2023; Mikhaylov, 2022b).

The specific nature of energy consumption and features of the power system of a metallurgical enterprise determine some difficulties in choosing one or another approach to improving efficiency (Bhuiyan et al., 2021; Dong et al., 2021, Mikhaylov, 2021b; Barykin et al., 2022b; Liu et al., 2022a, 2022b; Bhuiyan et al., 2022b; Danish et al., 2022a, 2022b; Saqib et al., 2021; Mukhametov et al., 2021, Candila et al., 2021; Mikhaylov & Grilli, 2022; Li et al., 2022a, 2022b, 2022c).

The limiting factor in the development of plant energy is the lack of investment in this area due to the significant cost of projects, which leads to the use of strategies aimed at optimizing consumption at the expense of internal resources. In this case, there is a need to activate the activities of personnel in the direction of rational use through the implementation of motivation mechanisms.

Implementation of a comprehensive and systematic energy efficiency improvement strategy will reduce costs and increase the company's competitiveness in the metallurgical industry.

At the state level, support is provided to enterprises aimed at improving the energy efficiency of production, in order to reduce costs per unit of output, reduce the consumption of traditional fuels and minimize carbon emissions during the operation of energy facilities. The main objective of such measures is to increase the competitiveness of domestic products on the world market and reduce the environmental impact of industrial activities. As part of the regulator's activities, both incentive and administrative measures can be applied to enterprises to encourage them to work in the field of improving the efficiency of using energy resources.

The main approach is to manage the process of using energy resources, which includes setting norms and limits of consumption and monitoring their use, developing an energy efficiency improvement program that determines the strategic direction of energy saving at all plants of the company, and formulating principles for motivating the company's personnel. This approach is fundamental, as it provides an initial statement of the problem of energy saving, and directs management to build a unified system. In conditions of a shortage of financing, due to the unstable

financial condition of the industry as a whole, this approach is able to ensure the maintenance of competitiveness of a single entity.

A promising direction for the development of the management system is the introduction of an approach to innovation management, since this area has a significant potential hidden in the human resource. The main indicator of efficiency in this area is the number of implemented improvement projects and innovation proposals aimed at reducing energy consumption. In addition, the creation of project teams capable of solving energy saving issues and implementing projects in the conditions of existing production is no less effective (Fang et al., 2021; Kayacık et al., 2022; Eti et al., 2022; Dinçer et al., 2023).

The development of traditional approaches makes it possible to form a systematic view of energy efficiency management, which is a set of organizational and technical measures, including using elements of training and motivation of personnel.

The driving force behind the transition to system work is the need to move away from the implementation of one-time investment projects in the energy infrastructure and create conditions for a continuous process of development and implementation of organizational and technical projects.

It is obvious that the list of business process managers includes energy conservation management processes, investment projects, financial management areas in the energy sector, as well as mechanisms for stimulating personnel to improve energy efficiency (Eti et al., 2023; Li et al. 2022a, 2022b, 2022c; Haiyun et al., 2021; Yuan et al., 2021). These processes are directly related to the main production processes and form the long-term energy efficiency strategy of the enterprise. Supporting business processes are ensuring the operability of equipment, through repairs to the energy infrastructure, supply and logistics, as well as operational control over production and financial flows and the implementation of approved programs in the field of energy conservation.

Given the previously identified problem of lack of investment in energy infrastructure, there is a need to develop recommendations for making a verified decision regarding the investment object (Carayannis et al., 2022; Li et al. 2022a, 2022b, 2022c; Yüksel et al., 2022; Mikhaylov et al., 2022a). First of all, the basis for making any decision is the initial information. Within the framework of the management system implemented at the enterprise, the source of initial information is internal audits. Based on the results of internal surveys, an analysis and development of measures aimed at improving energy efficiency is carried out. After that, the project database is formed with the division of projects into three categories.

The first group includes projects that are understood by most managers, characterized by relatively low capital investments and a low implementation period with a payback period of less than 1 year.

10.4 Conclusion

The next group includes projects that require significant capital investments, but have a fairly short payback period (2–3 years). As a rule, projects in this category involve technological changes in an entire subdivision or site and in some cases may have insufficient justification due to the lack of the necessary information and intellectual base. Further implementation of these projects requires the involvement of a third-party specialized organization in order to conduct an expert comprehensive survey and develop a feasibility study. The proposed step will minimize project risks in the context of the existing lack of knowledge and experience among managers and will provide the necessary support when making an investment decision in the field of energy conservation (Dong et al., 2022; Dinçer et al. 2022a, 2022b, 2022c; Zhang et al., 2022; Yüksel & Dinçer, 2022).

The third group of projects is considered the most difficult to understand, as it concerns global changes in the energy sector and affects the entire energy system. Projects in this category have a long payback period (5–10 years) and require significant capital investment. In addition, they are often characterized by a complete lack of knowledge and experience in their implementation and subsequent operation. It is for the third group of projects that the best option is to attract an organization that will take over risk assessment, calculation of economic indicators and costs for the implementation and operation of the project being implemented.

After classifying all the projects that were proposed based on the results of the energy audit, the fourth stage follows, at which it is necessary to finally form the entire portfolio of energy saving projects, indicate the essence of each of them and determine the technical and economic indicators of the project: the amount of funding, the expected economic effect, payback periods, etc. (Martínez et al., 2022; Sun et al., 2022; Kafka et al., 2022; Mukhtarov et al., 2022). At this stage, depending on the complexity of the project, the manager decides on whether to.

At the final stage, after deciding on the source of project financing, documentary confirmation is made by including it in the investment program or entering into an agreement with the company and moving to the implementation stage. At the implementation stage, control over the cost of financing and the quality of work performed should be established. An important aspect of the final stage is the creation of a database of best practices for implementing energy-efficient techniques, which can then be replicated to other enterprises of the company and the industry as a whole.

References

Alwaelya, S. A., Yousif, N. B. A., & Mikhaylov, A. (2021). Emotional development in pre-schoolers and socialization. *Early Child Development and Care, 191*, 16.

An, J., & Mikhaylov, A. (2020). Russian energy projects in South Africa. *Journal of Energy in Southern Africa, 31*(3), 58–64.

An, J., & Mikhaylov, A. (2021). Analysis of energy projects financial efficiency and renewable energy generation in Russia. *Finance: Theory and Practice, 25*(5), 79–91.

An, J., Mikhaylov, A., Dinçer, H., & Yüksel, S. (2022). Economic modelling of electricity generation: Long short-term memory and Q-rung Orthopair fuzzy sets. *Heliyon, 8*, e10759.

An, J., Mikhaylov, A., & Jung, S.-U. (2020b). The strategy of South Korea in the global oil market. *Energies, 13*(10), 2491.

An, J., Mikhaylov, A., & Jung, S.-U. (2021). A linear programming approach for robust network revenue management in the airline industry. *Journal of Air Transport Management, 91*, 101979.

An, J., Mikhaylov, A., & Kim, K. (2020c). Machine learning approach in heterogeneous group of algorithms for transport safety-critical system. *Applied Sciences, 10*(8), 2670.

An, J., Mikhaylov, A., & Moiseev, N. (2019b). Oil price predictors: Machine learning approach. *International Journal of Energy Economics and Policy, 9*(5), 1–6.

An, J., Mikhaylov, A., & Richter, U. H. (2020a). Trade war effects: Evidence from sectors of energy and resources in Africa. *Heliyon, 6*, e05693. https://doi.org/10.1016/j.heliyon.2020.e05693

An, J., Mikhaylov, A., & Sokolinskaya, N. (2019a). Machine learning in economic planning: Ensembles of algorithms. *Journal of Physics: Conference Series, 1353*, 012126.

Badr, A. M. N. A. A., Mohamed, T. I., Osman, N. A. Q., & Mikhaylov, A. (2022). A review of social media website users' interaction paths with governmental accounts during the COVID-19 pandemic. *Informatics, 9*, 50. https://doi.org/10.3390/informatics9030050

Barykin, S. E., Kapustina, I. V., Sergeev, S. M., Daniali, S. M., Kopteva, L. A., Semenova, G. N., Pryadko, I. P., Mikhaylov, A., Baboshkin, P., Datsyuk, P., & Senjyu, T. (2022a). Financial logistics models based on systematic approach improving management solutions. *F1000Research, 11*, –570. https://doi.org/10.12688/f1000research.111252.1

Barykin, S., Mikheev, A., Kiseleva, E., Putikhin, Y., Alekseeva, N., & Mikhaylov, A. (2022b). An empirical analysis of Russian regions' debt sustainability. *Economies, 10*(4), 296.

Bhuiyan, M. A., An, J., Mikhaylov, A., Moiseev, N., & Danish, M. S. S. (2021). Renewable energy deployment and COVID-19 measures for sustainable development. *Sustainability, 13*, 4418.

Bhuiyan, M. A., Dinçer, H., Yüksel, S., Mikhaylov, A., Danish, M. S. S., Pinter, G., Uyeh, D. D., & Stepanova, D. (2022b). Economic indicators and bioenergy supply in developed economies: QROF-DEMATEL and random forest models. *Energy Reports, 8*(2022), 561–570.

Bhuiyan, M. A., Dinçer, H., Yüksel, S., Mikhaylov, A., Danish, M. S. S., Pinter, G., et al. (2022a). Economic indicators and bioenergy supply in developed economies: QROF-DEMATEL and random forest models. *Energy Reports, 8*, 561–570.

Bhuiyan, M. A., Zhang, Q., Khare, V., Mikhaylov, A., Pinter, G., & Huang, X. (2022). Renewable energy consumption and economic growth nexus—A systematic literature review. *Frontiers in Environmental Science., 10*, 878394. https://doi.org/10.3389/fenvs.2022.878394

Candila, V., Maximov, D., Mikhaylov, A., Moiseev, N., Senjyu, T., & Tryndina, N. (2021). On the relationship between oil and exchange rates of oil-exporting and oil-importing countries: From the great recession period to the Covid-19 era. *Energies, 14*, 8065.

Carayannis, E., Kostis, P., Dinçer, H., & Yüksel, S. (2022). Balanced-scorecard-based evaluation of knowledge-oriented competencies of distributed energy investments. *Energies, 15*(21), 8245.

Conteh, F., Takahashi, H., Hemeida, A. M., Krishnan, N., Mikhaylov, A., & Senjyu, T. (2021). Hybrid grid-connected renewable power generation for sustainable electricity supply in Sierra Leone: Case study lungi town. *Sustainability, 13*(18), 1–20.

Daniali, S. M., Barykin, S. E., Kapustina, I. V., Khortabi, F. M., Sergeev, S. M., Kalinina, O. V., Mikhaylov, A., Veynberg, R., Zasova, L., & Senjyu, T. (2021). Predicting volatility index according to technical index and economic indicators on the basis of deep learning algorithm. *Sustainability, 2021*(13), 14011.

Danish, M. S. S., Bhattacharya, A., Stepanova, D., Mikhaylov, A., Grilli, M. L., Khosravy, M., & Senjyu, T. (2020). A systematic review of metal oxide applications for energy and environmental sustainability. *Metals, 10*(12), 1604.

Danish, M. S. S., Senjyu, T., Sabory, N. R., Khosravy, M., Grilli, M. L., Mikhaylov, A., & Majidi, H. (2021). A forefront framework for sustainable aquaponics modeling and design. *Sustainability, 13*, 9313.

Danish, M. S., Senjyu, T. S., Sabory, N. R., & Mikhaylov, A. (2022a). Lessons from COVID-19 conferring environmental re-engineering opportunity. In M. Danish & T. Senjyu (Ed.), *Eco-friendly and agile energy strategies and policy development* (pp. 99–118). IGI Global. https://doi.org/10.4018/978-1-7998-9502-2.ch005.

Danish, M. S., Senjyu, T. S., Sabory, N. R., & Mikhaylov, A. (2022b). Interplay consequences of COVID-19 on global environmental sustainability. In M. Danish, & T. Senjyu (Ed.), *Eco-friendly and agile energy strategies and policy development*. IGI Global. https://doi.org/10.4018/978-1-7998-9502-2.ch003.

Dayong, N., Mikhaylov, A., Bratanovsky, S., Shaikh, Z. A., & Stepanova, D. (2020). Mathematical modeling of the technological processes of catering products production. *Journal of Food Process Engineering, 43*(2), 1–9.

Denisova, V., Mikhaylov, A., & Lopatin, E. (2019). Blockchain infrastructure and growth of global power consumption. *International Journal of Energy Economics and Policy, 9*(4), 22–29.

Dinçer, H., Aksoy, T., Yüksel, S., & Hacioglu, U. (2022a). *Golden cut-oriented q-rung orthopair fuzzy decision-making approach to evaluation of renewable energy alternatives for microgeneration system investments. Mathematical Problems in Engineering*, 2022.

Dinçer, H., Yüksel, S., Çağlayan, Ç., Yavuz, D., & Kararoğlu, D. (2023). Can renewable energy investments be a solution to the energy-sourced high inflation problem?. In *Managing inflation and supply chain disruptions in the global economy* (pp. 220–238). IGI Global.

Dinçer, H., Yüksel, S., & Martínez, L. (2022b). Collaboration enhanced hybrid fuzzy decision-making approach to analyze the renewable energy investment projects. *Energy Reports, 8*, 377–389.

Dinçer, H., Yüksel, S., Mikhaylov, A., Barykin, S. E., Aksoy, T., & Hacioğlu, U. (2022c). Analysis of environmental priorities for green project investments using an integrated q-rung orthopair fuzzy modelling. *IEEE Access, 10*. https://doi.org/10.1109/ACCESS.2022.3174058

Dinçer, H., Yüksel, S., Mikhaylov, A., Pinter, G., & Shaikh, Z. A. (2022d). Analysis of renewable-friendly smart grid technologies for the distributed energy investment projects using a hybrid picture fuzzy rough decision-making approach. *Energy Reports, 8*, 11466–11477. https://doi.org/10.1016/j.egyr.2022.08.275

Dong, B., Ikonnikova, I., Rogulin, R., Sakulyeva, T., & Mikhaylov, A. (2021). Environmentaleconomic approach to optimization of transport communication in megacities. *Journal of Environmental Science and Health, Part A, 56*(6), 660–666.

Dong, W., Zhao, G., Yüksel, S., Dinçer, H., & Ubay, G. G. (2022). A novel hybrid decision making approach for the strategic selection of wind energy projects. *Renewable Energy, 185*, 321–337.

Dooyum, U. D., Mikhaylov, A., & Varyash, I. (2020). Energy security concept in Russia and South Korea. *International Journal of Energy Economics and Policy, 10*(4), 102–107.

Ermiş, A. M., & Güven, M. E. (2022). The role of green energy Investments in Energy Supply Security. In *Circular economy and the energy market* (pp. 67–77). Springer.

Eti, S., Dinçer, H., Gökalp, Y., Yüksel, S., & Kararoğlu, D. (2023). Identifying key issues to handle the inflation problem in the healthcare industry caused by energy prices: An evaluation with decision-making models. *Managing Inflation and Supply Chain Disruptions in the Global Economy*, 162–178.

Eti, S., Dinçer, H., Yüksel, S., & Gökalp, Y. (2022). Analysis of the suitability of the solar panels for hospitals: A new fuzzy decision-making model proposal with the T-spherical TOP-DEMATEL method. *Journal of Intelligent & Fuzzy Systems, Preprint*, 1–13.

Fang, S., Zhou, P., Dinçer, H., & Yüksel, S. (2021). Assessment of safety management system on energy investment risk using house of quality based on hybrid stochastic interval-valued intuitionistic fuzzy decision-making approach. *Safety Science, 141*, 105333.

Gura, D., Mikhaylov, A., Glushkov, S., Zaikov, M., & Shaikh, Z. A. (2022). Model for estimating power dissipation along the interconnect length in single on-chip topology. *Evolutionary Intelligence, 15*, 2369–2373. https://doi.org/10.1007/s12065-020-00407-7

Haiyun, C., Zhixiong, H., Yüksel, S., & Dinçer, H. (2021). Analysis of the innovation strategies for green supply chain management in the energy industry using the QFD-based hybrid interval valued intuitionistic fuzzy decision approach. *Renewable and Sustainable Energy Reviews, 143*, 110844.

Huang, Y., Masrur, H., Shigenobu, R., Hemeida, A. M., Mikhaylov, A., & Senjyu, T. (2021a). A comparative design of a campus microgrid considering a multi-scenario and multi-objective approach. *Energies, 14*, 2853.

Huang, Y., Yona, A., Takahashi, H., Hemeida, A. M., Mandal, P., Mikhaylov, A., Senjyu, T., & Lotfy, M. E. (2021b). Energy management system optimization of drug store operate electric vehicles charging station. *Sustainability, 14*, 1217836.

Kafka, K. I., Dinçer, H., & Yüksel, S. (2022). Impact-relation map of innovative service development regarding the sustainable growth for emerging markets. *Journal of the Knowledge Economy*, 1–24.

Kalinina, O. V., Barykin, S. E., Sergeev, S. M., Semenova, G. N., Fatkullina, A., Mikhaylov, A., & De La Poza, E. (2022). Smart city perspectives in post-pandemic governance: Externalities reduction policy. *F1000Research, 11*, 1032. https://doi.org/10.12688/f1000research.123195.1

Kayacık, M., Dinçer, H., & Yüksel, S. (2022). Using quantum spherical fuzzy decision support system as a novel sustainability index approach for analyzing industries listed in the stock exchange. *Borsa Istanbul Review, 22*(6), 1145–1157.

Khan, A. A., Laghari, A. A., Gadekallu, T. R., Shaikh, Z. A., Javed, A. R., Rashid, M., Estrela, V. V., & Mikhaylov, A. (2022). A drone-based data management and optimization using metaheuristic algorithms and blockchain smart contracts in a secure fog environment. *Computers and Electrical Engineering, 102*, 108234. https://doi.org/10.1016/j.compeleceng.2022.108234

Khan, A. A., Shaikh, Z. A., Baitenova, L., Mutaliyeva, L., Moiseev, N., Mikhaylov, A., Laghari, A. A., Idris, S. A., & Alshazly, H. (2021). QoS-ledger: Smart contracts and metaheuristic for secure quality-of-service and cost-efficient scheduling of medical-data processing. *Electronics, 10*, 3083.

Kou, G., Yüksel, S., & Dinçer, H. (2022). Inventive problem-solving map of innovative carbon emission strategies for solar energy-based transportation investment projects. *Applied Energy, 311*, 118680.

Li, J., Dinçer, H., Yüksel, S., Mikhaylov, A., & Barykin, S. E. (2022a). Bipolar q-ROF hybrid decision making model with golden cut for analyzing the levelized cost of renewable energy alternatives. *IEEE Access, 10*, 35900–35900. https://doi.org/10.1109/ACCESS.2022.3168315

Li, W., Yüksel, S., & Dinçer, H. (2022c). Understanding the financial innovation priorities for renewable energy investors via QFD-based picture fuzzy and rough numbers. *Financial Innovation, 8*(1), 1–30.

Li, J., Yüksel, S., Dınçer, H., Mikhaylov, A., & Barykin, S. E. (2022b). Bipolar q-ROF hybrid decision making model with golden cut for analyzing the levelized cost of renewable energy alternatives. *IEEE Access, 10*, 42507–42517.

Liu, L., Kato, T., Mandal, P., Mikhaylov, A., Hemeida, A. M., & Senjyu, T. (2021a). Multi-area power system load frequency control by using model predictive control by introducing renewable energy sources. *International Conference on Science & Contemporary Technologies (ICSCT), 2021*, 1–6. https://doi.org/10.1109/ICSCT53883.2021.9642521

Liu, L., Kato, T., Mandal, P., Mikhaylov, A., Hemeida, A. M., Takahashi, H., & Tomonobu, S. (2021b). Two cases studies of model predictive control approach for hybrid renewable energy systems. *AIMS Energy, 9*(6), 1241–1259.

Liu, Z.-J., Panfilova, E., Mikhaylov, A., & Kurilova, A. (2022a). COVID-19 crisis impact on the stability between parties in crowdfunding and crowdsourcing. *Wireless Personal Communications, 122*, 915–930.

Liu, Z., Panfilova, E., Mikhaylov, A., & Kurilova, A. (2022b). Assessing stability in the relationship between parties in crowdfunding and crowdsourcing projects during the COVID-19 crisis. *Journal of Global Information Management (JGIM), 30*(4), 1–18. https://doi.org/10.4018/JGIM.297905

Martínez, L., Dinçer, H., & Yüksel, S. (2022). A hybrid decision making approach for new service development process of renewable energy investment. *Applied Soft Computing, 109897*.

Mehta, R., Verghese, J., Mahajan, S., Barykin, S., Bozhuk, S., Kozlova, N., Kapustina, I., Mikhaylov, A., Naumova, E., & Dedyukhina, N. (2022). Consumers' behavior in conversational commerce marketing based on messenger chatbots. *F1000Research, 11*, 647. https://doi.org/10.12688/f1000research.122037.1

Mikhaylov, A. (2018). The yield of the carry trade strategy. *Finance: Theory and Practice, 22*(3), 52–63. https://doi.org/10.26794/2587-5671-2018-22-3-52-63

Mikhaylov, A. (2020a). Cryptocurrency market analysis from the open innovation perspective. *Journal of Open Innovation: Technology, Market, and Complexity, 6*(4), 197.

Mikhaylov, A. (2020b). Geothermal energy development in Iceland. *International Journal of Energy Economics and Policy, 10*(4), 31–35.

Mikhaylov, A. (2020c). Cryptocurrency market development: Hurst method. *Finance: Theory and Practice, 24*(3), 81–91.

Mikhaylov, A. (2021a). Development of Friedrich von Hayek's theory of private money and economic implications for digital currencies. *Terra Economicus, 19*(1).

Mikhaylov, A. (2021b). Lichens as indicators of atmospheric pollution in urban ecosystems. *Israel Journal of Ecology & Evolution, 67*(1–2), 60–68. https://doi.org/10.1163/22244662-bja10016

Mikhaylov, A. (2022a). Efficiency of renewable energy generation in Russia. *Anais da Academia Brasileira de Ciências, 94*(4), e20191226. https://doi.org/10.1590/0001-3765202220191226

Mikhaylov, A. (2022b). Sustainable development and renewable energy: A new view to a global problem. *Energies, 15*, 1397. https://doi.org/10.3390/en15041397

Mikhaylov, A., Bhatti, I. M., Dinçer, H., & Yüksel, S. (2022a). Integrated decision recommendation system using iteration-enhanced collaborative filtering, golden cut bipolar for analyzing the risk-based oil market spillovers. *Computational Economics*, 1–34.

Mikhaylov, A., Bhatti, I. M., Dinçer, H., & Yüksel, S. (2022c). Integrated decision recommendation system using iteration-enhanced collaborative filtering, golden cut bipolar for analyzing the risk-based oil market spillovers. *Computational Economics*. https://doi.org/10.1007/s10614-022-10341-8

Mikhaylov, A., Burakov, D., & Didenko, V. (2019). Relationship between oil price and macroeconomic indicators in Russia. *Finance: Theory and Practice, 23*(2), 105–116. https://doi.org/10.26794/2587-5671-2019-23-2-105-116

Mikhaylov, A., Dinçer, H., & Yüksel, S. (2023). Analysis of financial development and open innovation oriented fintech potential for emerging economies using an integrated decision-making approach of MF-X-DMA and golden cut bipolar q-ROFSs. *Financ Innov, 9*, 10. https://doi.org/10.1186/s40854-022-00234-w

Mikhaylov, A., & Grilli, M. L. (2022). Machine learning methods and sustainable development: Metal oxides and multilayer metal-oxides. *Metals, 12*(4).

Mikhaylov, A., Moiseev, N., Aleshin, K., & Burkhardt, T. (2020). Global climate change and greenhouse effect. *Entrepreneurship and Sustainability Issues, 7*(4), 2897–2913. https://doi.org/10.9770/jesi.2020.7.4(21)

Mikhaylov, A., & Tarakanov, S. (2020). Development of Levenberg-Marquardt theoretical approach for electric network. *Journal of Physics: Conference Series, 1515*, 052006.

Mikhaylov, A., Yumashev, A., & Kolpak, E. (2022). Quality of life, anxiety and depressive disorders in patients with extrasystolic arrhythmia. *Archives of Medical Science, 18*(2), 328–335. https://doi.org/10.5114/aoms.2020.101359

Moiseev, N., Mikhaylov, A., Dinçer, H., & Yüksel, S. (2023). Effects of market capitalization shocks for open innovation models in e-commerce industry: Golden cut QROF MCDM analysis. *Financ Innov, 9*, 32.

Moiseev, N., Mikhaylov, A., Varyash, I., & Saqib, A. (2020). Investigating the relation of GDP per capita and corruption index. *Entrepreneurship and Sustainability Issues, 8*(1), 780–794.

Moiseev, N., Sorokin, A., Zvezdina, N., Mikhaylov, A., Khomyakova, L., & Danish, M. S. S. (2021). Credit risk theoretical model on the base of DCC-GARCH in time-varying parameters framework. *Mathematics, 9*, 2423. https://doi.org/10.3390/math9192423

Mukhametov, A., Bekhorashvili, A., Avdeenko, A., & Mikhaylov, A. (2021). The impact of growing legume plants under conditions of Biologization and soil cultivation on chernozem fertility and productivity of rotation crops. *Legume Research, 44*, 12.

Mukhtarov, S., Yüksel, S., & Dinçer, H. (2022). The impact of financial development on renewable energy consumption: Evidence from Turkey. *Renewable Energy, 187*, 169–176.

Mutalimov, V., Kovaleva, I., Mikhaylov, A., & Stepanova, D. (2021). Assessing regional growth of small business in Russia. Entrepreneurial business and economics review, 9(3), 119–133. 10.15678/EBER.2021.090308.

Nie, D., Panfilova, E., Samusenkov, V., & Mikhaylov, A. (2020). E-learning financing models in Russia for sustainable development. *Sustainability, 12*(11), 4412.

Nyangarika, A., Mikhaylov, A., Muyeen, S. M., Yadykin, V., Mottaeva, A., Pryadko, I., Barykin, S., Fomenko, N., Rykov, G., & Shvandar, K. (2022). Energy stability and decarbonization in developing countries: Random Forest approach for forecasting of crude oil trade flows and macro indicators. *Frontiers in Environmental Science, 10*, 1031343. https://doi.org/10.3389/fenvs.2022.1031343

Nyangarika, A., Mikhaylov, A., & Richter, U. (2019a). Influence oil price towards economic indicators in Russia. *International Journal of Energy Economics and Policy, 9*(1), 123–129.

Nyangarika, A., Mikhaylov, A., & Richter, U. (2019b). Oil price factors: Forecasting on the base of modified auto-regressive integrated moving average model. *International Journal of Energy Economics and Policy, 9*(1), 149–159.

Nyangarika, A., Mikhaylov, A., & Tang, B.-J. (2018). Correlation of oil prices and gross domestic product in oil producing countries. *International Journal of Energy Economics and Policy, 8*(5), 42–48.

Saqib, A., Chan, T.-H., Mikhaylov, A., & Lean, H. H. (2021). Are the responses of sectoral energy imports asymmetric to exchange rate volatilities in Pakistan? Evidence from recent foreign exchange regime. *Frontiers in Energy Research, 9*, 614463. https://doi.org/10.3389/fenrg.2021.614463

Sediqi, M. M., Nakadomari, A., Mikhaylov, A., Krishnan, N., Lotfy, M. E., Yona, A., & Senjyu, T. (2022). Impact of time-of-use demand response program on optimal operation of Afghanistan real power system. *Energies, 15*, 296.

Shaikh, Z. A., Kraikin, A., Mikhaylov, A., & Pinter, G. (2022). Forecasting stock prices of companies producing solar panels using machine learning methods. *Complexity, 2022*, 9186265. https://doi.org/10.1155/2022/9186265

Shaikh, Z. A., Moiseev, N., Mikhaylov, A., & Yüksel, S. (2021). Facile synthesis of copper oxide-cobalt oxide/nitrogen-doped carbon (Cu2O-Co3O4/CN) composite for efficient water splitting. *Applied Sciences., 11*, 9974. https://doi.org/10.3390/app11219974

Sun, L., Peng, J., Dinçer, H., & Yüksel, S. (2022). Coalition-oriented strategic selection of renewable energy system alternatives using q-ROF DEMATEL with golden cut. *Energy, 256*, 124606.

Tamashiro, K., Alharbi, T., Mikhaylov, A., Hemeida, A. M., Krishnan, N., Lotfy, M. E., & Senjyu, T. (2021). Investigation of home energy management with advanced direct load control and optimal scheduling of controllable loads. *Energies, 14*, 7314. https://doi.org/10.3390/en14217314

Tamashiro, K., Omine, E., Krishnan, N., Mikhaylov, A., Hemeida, A. M., & Senjyu, T. (2023). Optimal components capacity based multi-objective optimization and optimal scheduling based MPC-optimization algorithm in smart apartment buildings. *Energy & Buildings, 278*, 112616. https://doi.org/10.1016/j.enbuild.2022.112616

Uyeh, D. D., Asem-Hiablie, S., Park, T., Kim, K.-M., Mikhaylov, A., Woo, S., & Ha, Y. (2021). Could japonica rice be an alternative variety for increased global food security and climate change mitigation? *Food, 10*, 1869. https://doi.org/10.3390/foods10081869

Varyash, I., Mikhaylov, A., Moiseev, N., & Aleshin, K. (2020). Triple bottom line and corporate social responsibility performance indicators for Russian companies. *Entrepreneurship and Sustainability Issues, 8*(1), 313–331.

Xu, X., Yüksel, S., & Dinçer, H. (2022). An integrated decision-making approach with Golden cut and bipolar q-ROFSs to renewable energy storage investments. *International Journal of Fuzzy Systems*, 1–14.

Yuan, G., Xie, F., Dinçer, H., & Yüksel, S. (2021). The theory of inventive problem solving (TRIZ)-based strategic mapping of green nuclear energy investments with spherical fuzzy group decision-making approach. *International Journal of Energy Research, 45*(8), 12284–12300.

Yüksel, S., & Dinçer, H. (2022). Identifying the strategic priorities of nuclear energy investments using hesitant 2-tuple interval-valued Pythagorean fuzzy DEMATEL. *Progress in Nuclear Energy, 145*, 104103.

Yüksel, S., Dinçer, H., Eti, S., & Adalı, Z. (2022). Strategy improvements to minimize the drawbacks of geothermal investments by using spherical fuzzy modelling. *International Journal of Energy Research.*

Yumashev, A., & Mikhaylov, A. (2020). Development of polymer film coatings with high adhesion to steel alloys and high wear resistance. *Polymer Composites, 41*(7), 2875–2880.

Yumashev, A., Ślusarczyk, B., Kondrashev, S., & Mikhaylov, A. (2020). Global indicators of sustainable development: Evaluation of the influence of the human development index on consumption and quality of energy. *Energies, 13*, 2768.

Zhang, Y., Zhang, Y., Gong, C., Dinçer, H., & Yüksel, S. (2022). An integrated hesitant 2-tuple Pythagorean fuzzy analysis of QFD-based innovation cost and duration for renewable energy projects. *Energy, 248*, 123561.

Zhao, Q., Cherkasov, S., Avdeenko, A., Kondratenko, L., & Mikhaylov, A. (2021). Integral estimate of the added value of agricultural crops in the synergetic agriculture on the example of Vicia faba (Vicia faba L.). *Polish Journal of Environmental Studies, 30*(5), 1–9. https://doi.org/10.15244/pjoes/131949