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Issue Article

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MANAGING ENERGY SECURITY ASSESMENT OF SELF-SUFFICIENCY IN GEORGIA

***Abstract**: This paper evaluates Georgia's energy security by analyzing its energy balance across diverse sources, including fossil fuels, hydropower, and renewables. Using the IEA's short-term energy security model, the study identifies key energy sources and pathways for enhancing self-sufficiency. A critical dependency on imported fossil fuels is revealed, with petroleum products and natural gas comprising 56% of the energy balance, 98% being imported. While hydropower dominates (44%), other renewables remain limited (1%). The paper explores strategies for bolstering energy security, including reducing fossil fuel reliance, diversifying energy sources, promoting energy efficiency, and strengthening regional cooperation. These findings provide crucial insights for policymakers and stakeholders to guide strategic decisions and investments towards a more self-sufficient and sustainable energy future for Georgia.*

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Introduction

In an era of geopolitical shifts and increasing energy demands, ensuring reliable and sustainable energy sources has become paramount for nations worldwide. Energy security, the ability to access and maintain affordable, reliable, and environmentally responsible energy supplies, is no longer merely an economic imperative but a critical pillar of national security and societal well-being. Georgia, situated at the crossroads of Europe and Asia, faces a unique set of energy security challenges and opportunities.

One of the key challenges for Georgia is its heavy reliance on imported energy sources, with the country only satisfying 30-35% of its energy consumption through local generation [2, p. 196]. This dependence on external suppliers, particularly for natural gas and oil, makes the country vulnerable to supply disruptions, price volatility, and geopolitical pressures. Moreover, Georgia's rapidly growing domestic energy demand, which increases at a yearly rate of 3% [11, p.1076], further underscores the urgency of developing more sustainable energy strategies. This paper will examine the complexities of Georgia's energy landscape, exploring potential pathways to enhance its energy security through a combination of increesed domestic generation, particularly from untapped hydro power resources [17, p. 237], improved energy efficiency measures, and strategic diversification of energy sources.

LITERATURE REVIEW

Energy security is a multifaceted concept influenced by various factors, including renewable energy potential, import dependency, energy balance, geopolitical dynamics, international energy relations, and policy [3, p. 1740] [16, p. 5963].

One crucial aspect is the role of renewable energies in achieving energy independence. Similar to the experiences of new EU member states [10, p.18], expanding renewable energy sources in Georgia holds significant potential for reducing its reliance on energy imports. Currently, Georgia's energy mix heavily favors hydropower, which, while advantageous as a renewable resource, presents challenges related to seasonal variability and the potential impact of climate change on water resources [21, p. 280]. This dependence on water resources introduces vulnerabilities, as hydropower generation is susceptible to fluctuations in precipitation and long-term shifts in climate patterns [5, p. 342].

Beyond expanding renewable generation, efficient energy management is crucial for bolstering energy security. For instance, advanced technologies like AB-Net, a deep learning model, can provide accurate forecasting of renewable energy generation, enabling more efficient energy management strategies [7, p.2456]. Given the interconnections of water resources and energy production, particularly in hydropower-dependent regions like Georgia, it is essential to develop robust models and assessments to project future water availability and hydropower generation under different climate change scenarios [15, p. 3278]. Climate change-induced shifts in river flow patterns and reservoir management challenges directly impact hydropower production [13, p. 2541]. Therefore, adaptation measures, including infrastructure upgrades and policy adjustments, are necessary to ensure sustainable hydropower production in a changing climate. Implementing more efficient water storage and release strategies can help mitigate the negative impacts of climate change on hydropower generation by adapting to altered river flows.

Geopolitical factors play a significant role in shaping energy security. Georgia's strategic location at the crossroads of Europe and Asia makes it a critical transit point for energy resources, particularly natural gas and oil, flowing from the Caspian Sea region [14, p. 69]. However, this strategic positioning also exposes the country to risks associated with political instability and potential conflicts that could disrupt the flow of these vital resources [3, p.1740]. The Russia-Ukraine war, for example, has drastically altered the EU's perspective on Russian energy resources, prompting a policy shift towards reducing reliance on Russian energy. The EU's current policy focuses on mitigating the energy crisis by seeking alternative suppliers, accelerating the adoption of renewable energy, and implementing energy efficiency measures [4, p.47].

To reduce its dependence on imported energy, the Georgian government has been actively investing in modernizing and expanding its domestic energy infrastructure. However, these efforts face challenges posed by financial, technical, and regulatory barriers, which have hindered the pace of progress [3, p.1741]. Furthermore, national approaches to energy consumption and individual country policies significantly impact energy independence, as demonstrated by the case studies of six European countries [8, p. 270] [18, p. 103]. The integration of green approaches in production processes can enhance energy efficiency and represents a crucial step towards greater energy independence [9, p.604].

Therefore, navigating the complex interplay between international energy markets, geopolitical dynamics, and domestic energy policies is crucial for Georgia to achieve long-term energy security and advance its strategic interests.

METHODOLOGY

This research employs a mixed-methods approach, integrating both quantitative and qualitative methods to investigate energy security in Georgia. The quantitative analysis leverages secondary data of energy security indicators. This data is analyzed using two primary methods: descriptive statistics and MOSES models. The model of Short-term Energy

Security is employed to assess the security of supply for individual energy sources in Georgia. This model focuses on primary and secondary energy sources, evaluating both external risks (e.g., import disruptions) and domestic resilience factors (see Table 1). It's important to note that this version of the MOSES model does not explicitly address the security of renewable energy sources like solar, wind, and ocean energy, as these are considered within the broader context of electric power system security.

Table 1: Dimensions of energy security with the MOSES methodology

	Risks	**Resilience**
External	Risks related to disruption of energy imports	sourcing, responding to the disruptions in energy imports by changing suppliers or supply routes
	Risks associated with local energy production and conversion	Local ability to respond to disruptions in energy supply, for example by having fuel reserves.

Source: IEA (2023)

The MOSES methodology analyzes four key dimensions of energy security using 35 indicators (see Table 2) to assess the risk level and resilience of different energy resources within national energy systems. Data sources used in the MOSES method include the IEA, the Organization for Economic Co-operation and Development, the Nuclear Energy Agency, the World Bank, the International Atomic Energy Agency, and Gas Infrastructure Europe.

Table 2: **Table of risk and resilience indicators used in the MOSES method**

Source of energy	**Dimension**		**Indicator**	**Resources**
Natural gas	External	risk	Dependence on net imports	IEA
			Political stability of suppliers	IEA, OECD
		resilience	Entry points (LNG ports and pipelines)	IEA
			Diversity of suppliers	IEA
	Domestic	risk	*Offshore* production	IEA
		resilience	Daily issued volume from storage	IEA
			Natural gas supply volume	IEA
Oil products	External	risk	Dependence on net import of oil products	IEA
		resilience	Diversity of suppliers	IEA
			Entry points (ports, rivers and pipelines)	IEA
	Domestic	risk	Number of refineries	IEA
		resilience	Flexibility of processing infrastructure	IEA
			average reserve level	IEA
Hydropower	Domestic	risk / resilience	Seasonal variation in production	IEA
Coal	External	risk	Dependence on net imports	IEA
			Political stability of suppliers	IEA, OECD
		resilience	Points of entry (ports and railways)	IEA
			Diversity of suppliers	IEA
	Domestic	risk	Share of underground mining	IEA

Biofuels and waste	External	risk	Net import dependence	IEA
		resilience	Entry points (ports)	IEA
	Domestic	risk	Instability of agricultural products	IEA
Crude oil	External	risk	Dependence on net imports	IEA
			Political stability of suppliers	IEA, OECD
		resilience	Entry points (ports and pipelines)	IEA
			Diversity of suppliers	IEA
	Domestic	risk	*Offshore* production	IEA
			Instability of domestic production	IEA
		resilience	Average level of storage	IEA

Source: IEA (2023)

Based on Georgia's energy balance, the following energy products were grouped for analysis: coal, crude oil, petroleum products, natural gas, hydro, geothermal, solar, wind, biofuels and waste, and electricity (import-export), as illustrated in Table 3. Georgia's energy balance reveals a heavy reliance on fossil fuels, with oil products, natural gas, and coal comprising 56% of the total energy mix. Hydropower currently dominates electricity generation, accounting for 44% of the energy balance. However, the share of other renewable sources, such as solar and wind power, remains limited to just 1%. Furthermore, Georgia's energy security is challenged by a significant import dependency, with 98% of its petroleum products and natural gas sourced from external suppliers.

Table 3: Energy balance of Georgia 2022 (Terajoules)

Coal	9877.5
Crude oil	312.5
Oil products	57108.6
Natural gas	120809.6
Hydro	38777
Geothermal, solar, etc.	91.1
Biofules and waste	1411.4
Electriccity	501.2

Source: Geostat (2022)

The main goal of working with these indicators is to combine and interpret them in accordance with transparent and logical energy policy objectives. The MOSES method aggregates indicators in two stages: 1. **Indicator Categorization:** Three levels of values (low, medium, and high) are established for each indicator, primarily based on ranges of indicator values observed in IEA countries; 2. **Energy Security Profile:** This categorization defines each country's energy security profile by combining indicators. This process considers how individual risks can exacerbate each other and how specific resilience measures can mitigate those risks.

The MOSES model, primarily focuses on traditional energy sources. Regarding the limitations of using the Moses model, it should be noted that Georgia has the potential of renewable energy such as hydropower, wind and solar energy. In addition, Georgia's geopolitical location and changes in international market conditions may limit the effectiveness of Moses' model. However, based on the energy balance of Georgia, the Moses model allows determining ways to optimize the use of local resources, reduce dependence on energy imports and improve energy security.

RESULTS AND DISCUSSION

When assessing Georgia's energy security according to the Moses model, we got the following picture:

Natural gas. The share of natural gas in the total supply of energy resources is about 40%. Gas is the most widely consumed primary energy resource in Georgia. The natural gas sector is one of the most dynamically developing segments of the country. 99.5% of natural gas consumed in Georgia is imported. The country has no gas storage and peak winter consumption is entirely dependent on imports and the efficiency of the import infrastructure. (see Table 4).

Table 4: The range of indicators of natural gas of Georgia

Dimension	Indicator		Low	Average	High
External risk	*Import dependency*				*99.5%*
	Political stability of suppliers				*≥4.0*
Domestic risk	*Share of offshore production*		*0*		
External resilience	*Diversity of suppliers*		*>0.6*		
	Entry points	*Ports*	*0*		
		Pipelines		*4*	
Domestic resilience	*Send-out capacity*		*0*		
	Natural gas consumption volume, bcm/$1000 USD				*186*

Source: author's work.

The intensity of natural gas consumption is also used as an indicator of internal sustainability, ie the amount of natural gas consumed divided by the GDP equivalent of 1000 dollars. This indicator reflects the resilience of the country's economy to gas interruptions. The classification of MOSES method for measuring gas intensity offers 3 levels, and the average is 20-60 m3/1000USD. Georgia exceeds this limit almost three times, which indicates highly unproductive use of natural gas. According to the classification of natural gas, Georgia falls into group E (see Table 5).

Considering domestic and external factors, Georgia joins the group of countries with high risk and low resilience. The main reason for this is the country's almost 100% dependence on imported natural gas. With political stability and diversification of suppliers, Georgia is also a high-risk and low-resilience country, meaning it is highly susceptible to physical supply disruptions. All this is also exacerbated by the absence of a liquefied natural gas (LNG) receiving port. In terms of internal natural gas risk, the situation should be considered formally positive, as the country has no offshore production and minimal land-based natural gas production. In order to reduce risks in the natural gas sector, it is important for Georgia to diversify natural gas suppliers and build gas storage. In the long term, the construction of an LNG port is also possible, which will contribute to resilience in case of damage to natural gas pipelines.

Table 5: Natural gas: security profiles

Group	Countries with:	Number of countries
E	Import ≥70% of their natural gas supply and have 3-4 pipelines and/or 1-2 LNG ports with low supplier diversity and maximum send-out capacity	3

Source: author's work.

Oil products. Oil products consumed can be defined as domestic or imported. Each of these two supply streams is associated with specific risks and resilience factors. Imported products may be subject to delivery delays due to damage to trade, delivery routes or infrastructure. When supplying domestic crude products, the risks of refinery outages and delays in crude oil supply should be considered. The analysis in this section is carried out separately for middle distillates, motor gasoline and other oil products. The middle distillate group includes: gas/diesel oil, kerosene type jet fuel and other kerosene.

Georgia imports oil products from 12 different countries. The oil products market is fully liberalized and competitive. Several dominant companies participate in the market, including "Socar", "Lukoil", "Gulf", "Wissol" and "Rompetrol", which carry out import and retail trade of oil products. The country does not have adequate strategic reserves of oil products and is mainly dependent on the reserves of these oil companies. According to the MOSES methodology, petroleum products were evaluated in three categories: 1. Gasoline, 2. Middle distillates - diesel, kerosene, aviation fuel, 3. Other oil products - heavy fuel oil, lubricants and some jet fuels. Accordingly, the evaluation indicators according to oil products look like this (see Table 6):

Table 6: Range of oil product indicators

Dimension	Indicator		Low	Average	High
External risk	*Deficit*	*Gasoline*			*100%*
		Middle Distillates			*98%*
		Other oil products			*97%*
Domestic risk	*Oil security*				*A*
	Number of operating refineries		*1*		
External resilience	*Diversity of suppliers*				*0.30*
	Entry points	*Ports*		*3*	
		Pipelines		*0*	
Domestic resilience	*Flexibility of refining infrastructure (Nelson complexity index)*		*<6.0*		
	Average stock levels (2010) depending on the number of weeks	*Gasoline*			*6*
		Middle Distillates			*4*
		Other oil products			*2*

Source: author's work.

Due to the variety of suppliers, there is no shortage of all oil products according to the indicators of 2023. Average inventory levels were classified as low. Considering the low assessment of the Nelson Complexity Index, Georgia was placed in the D group category in the oil products sector (see Table 7). Georgia can improve its energy security by building oil product stocks/reserves.

According to the Moses method, Georgia was assigned category D, since almost 100% of oil products are imported. Reserves of oil products in all countries vary between 3-6 weeks. The indicators of 2023 show the diversity of oil product supplying countries, however, the insufficient number of oil product storages in the country does not allow importing a large number of products.

Table 7: Oil product security profile for Georgia

Group	Countries that:	No of countries
D	Import >45% of their gasoline consumption and have 3-6 weeks of gasoline stocks, one oil product pipeline, and low supplier diversity.	1
D	Import >45% of their middle distillates consumption with moderate supplier diversity and 3-6 weeks of middle distillates stocks.	2
D	Import ≤45% of their other oil products consumption and are ➢ in Crude oil groups D or E with either ➢ A moderately flexible refining portfolio and 3-6 weeks of other oil products or ➢ a highly flexible refining portfolio and <3 weeks of other oil products stocks or ➢ Import >45% of their other oil products consumption with moderate supplier diversity and <3 weeks of other oil products stocks	6

Source: author's work.

Crude oil. Georgia is a transit country for crude oil, which is transported from the Caspian region through Georgia to the world market. Despite the fact that significant volumes of crude oil are transported through pipelines and railways in Georgia, this resource is practically not consumed. Even a small amount of oil produced in the country is exported. Only one small capacity oil refinery is operating. Therefore, the demand for oil products in the country is completely satisfied by imports. Oil is used for transit purposes, not for self-consumption. Accordingly, the indicators of the MOSES method for oil are placed in the following intervals (see Table 8).

Table 8: Range of crude oil indicators

Dimension	Indicator		Low	Average	High
External risk	*Import dependency*				*99.5%*
	Political stability of suppliers				*≥4.0*
Domestic risk	*Volatility of production*				*>20%*
	Share of offshore production		*0*		
External resilience	*Diversity of suppliers*			*0.6*	
	Entry points	*Ports*		*3*	
		Pipelines			*2*
Domestic resilience	*Storage levels (days)*		*70*		

Source: author's work.

Crude oil indicators, due to the lack of information for Georgia, the full capacity of the storage was used instead of the average annual crude oil reserve. The results of the indicators in the oil sector are satisfactory, except for the low rate of political stability of the oil supplying countries and the relatively small number of oil pipelines, although their impact on energy security is insignificant, since the country does not consume crude oil. The internal response to risks is formally high, because the full (including transit) storage volumes were considered when estimating oil reserves. According to the crude oil MOSES methodology, Georgia was placed in Group A along with five developed countries that are members of the OECD (see Table 9).

Table 9: Security profiles of crude oil

Group	Countries that	No. of countries
A	Export crude oil or import ≤15% of their crude oil consumption	5

Source: author's work.

However, due to the uniqueness of the current situation, it is difficult to draw conclusions in terms of energy policy, since the assessment indicates the absence of an operational oil refinery, not the country's oil resource wealth.

Coal. Tkibul-Shaori, Tkvarcheli and Akhaltsikhe coal deposits are known in Georgia. Coal is one of the main energy sources; It is also widely used in ferrous and non-ferrous metallurgy, chemical and transport industries, household purposes, etc.

However, coal does not play an important role in the country's energy security. There is only one coal-fired thermal power plant of 13 MW capacity in Georgia, which is not functioning. The indicators of coal in the MOSES energy security classification are given in Table 10. In the classification of coal, Georgia falls into group B (see Table 11).

Table 10: Range of coal indicators

Dimension	Indicator		Low	Average	High
External risk	*Import dependency*			*58%*	
Domestic risk	*Share of underground mining*				*100%*
External resilience	*Diversity of suppliers*				*0.9*
	Import infrastructure (entry points)	*Sea ports*			*2*
		Railways			*1*

Source: author's work.

Table 11: Coal security profiles

Group	Countries that:	No. of countries
B	Import 30%-60% of coal with the share of underground mining >40%.	4

Source: author's work.

Two important indicators related to coal are import dependence and mining share. The first indicator places the country in group A or B, however, the share of mining is decisive for the final classification, which reaches a maximum of 60% in OECD countries, while in Georgia it is 100%, which carries a higher risk.

Biomass and waste. According to the energy balance, a total of 4 types of biomass are used, of which firewood has the highest share. Although Georgia does not import this source of energy and is not dependent on imports, all biomass is obtained from one source and this is the most important indicator (see Table 12).

Table 12: Range of biomass and waste indicators

Dimension	Indicator	Low	Average	High
External risk	*Import dependency*	*0.15*		
Domestic resilience	*Diversity of suppliers*			*0.99*

Source: author's work.

Today, 100% of the biomass is firewood, which causes serious problems, deforestation and loss of biodiversity. It is important for Georgia to diversify its sources of biomass and increase the share of pellets, briquettes and other solid biofuels in consumption, which will be produced from residual biomass. In addition, increasing the efficiency of firewood consumption will also affect the reduction of demand. Biomass and waste were included in group C (see Table 13).

Table 13: Biomass and waste Security profiles

Group	Countries that:	No. of countries
C	Low diversity of sources (with high concentration of sources >0.5 which means at least 75% of their biomass and waste comes from a single source) and low import dependency (16%-24%)	3

Source: author's work.

Hydro power. Hydro power is the most important part of the energy sector of Georgia, providing 70-75% of the total domestic supply. In the absence of fossil resources, the MOSES method assesses the risks associated with hydro power based on the variability of hydro logical regimes, which measures both the risks and the sustainability of hydro power generation (considering reservoir capacity). A 10-year series of annual output of the main hydroelectric power stations was used to assess the stability of the hydro potential. The instability of hydro power production for Georgia (2013 – 2022) is 10%.

In terms of hydro power security, Georgia was included in group A (see table 14). For Georgia, the instability of hydro power production is a risk considering the weather, as for the resilience, the sustainability of the hydro power system should be considered, for example insufficient reservoirs in relation to the annual consumption. This approach is quite simplified in relation to hydro power, when evaluating a similar type of energy source, the geographical location of hydro power stations and the number of reservoir stations should also be considered.

Table 14: Hydro power Security Profiles

Group	**Countries with:**	**No. of countries**
A	Volatility of hydro power production <=10%	**12**

Source: author's work.

Key findings of MOSES energy security indicators for Georgia are summarized in the table below (see Table 15).

Table 15: Security rating of Georgia

Primary energy	Security rating
Crude oil	**A**
Oil products	
Gasoline	**D**
Middle distillates	**D**
Other oil products	**D**
Natural gas	**E**
Coal	**B**
Biomass and waste	**C**
Hydro power	**A**

Source: author's work.

Except for oil products and natural gas, the research shows moderately positive ratings, however, these two sources have a significant share in the energy balance of Georgia. It is possible to use the MOSES methodology for the summary rating of Georgia. Assign weighted points according to their share in the energy balance. If we show the ratings of the A-E classification in numbers from 1 to 5, and weigh the ratings obtained by different energy sources according to their share in the energy balance of Georgia, we will get a total energy security index of 3.2. Which is close to C category.

CONCLUSION AND RECOMMENDATION

This research highlights several key findings regarding Georgia's energy landscape and pathways to enhanced energy security:

- **Strategic Crude Oil Refining:** Given the identified dependency on imported oil products (98%), developing a high-capacity crude oil refinery within Georgia is crucial. This strategic investment would leverage crude oil as a pillar of energy supply and security, bolstering economic stability and mitigating reliance on external sources.
- **Enhancing Energy Security through Storage:** Establishing domestic storage for oil products and natural gas is essential to buffer against potential import disruptions and enhance energy security. This is particularly critical considering the inherent risks associated with natural gas supply and the need to diversify suppliers.
- **Maximizing Hydropower and Expanding Renewables:** Recognizing the dominance of hydropower (44%) in the energy mix, accelerating the utilization of Georgia's untapped hydropower potential is crucial. This includes constructing regulating hydropower plants to optimize energy generation. Simultaneously, expanding the portfolio of renewable energy sources beyond hydropower, such as solar and wind power, is essential for diversifying generation sources and addressing the current limited share of these renewables.
- **Reassessing Biomass Sustainability:** The current low demand for biomass due to expanding gas supply infrastructure necessitates a reassessment of its role in Georgia's energy mix. New approaches are needed to harness biomass energy effectively and sustainably.

By strategically implementing these recommendations, Georgia can strengthen its energy security and foster a more sustainable energy future. Future research could explore more comprehensive energy system models and identify specific policy measures and investment strategies to achieve these goals.

References:

1. Chokheli, E., & Narmania, D. (2015). Information Technologies in Management and Prospects to Improve Their Use by Georgian Companies, *International Journal of Recent Scientific Research* 6(9), (2015). 4.
2. Chomakhidze, D. (2016, September 1). Energy balance of Georgia. *Elsevier BV*, 14(3), 196-200. https://doi.org/10.1016/j.aasci.2016.08.00
3. Chomakhidze, D., Zivzivadze, O., Kachkachishvili, P., & Kiladze, A. (2018, January 1). The Role and Importance of the Energy Saving in Georgia. *Scientific Research Publishing,* 08(10), 1740-1745. https://doi.org/10.4236/tel.2018.8101
4. Darmayadi, A., & Megits, N. (2023). The impact of the Russia-Ukraine war on the European

Union economy. *Journal of Eastern European and Central Asian Research (JEECAR)*, 10(1), 46–55. https://doi.org/10.15549/jeecar.v10i1.1079

5. Fîță, N D., & Grigorie, E. (2021, January 1). Factors of achieving and ensuring energy security in the context of national and EuroAtlantic security. *EDP Sciences*, 342, 04011-04011. https://doi.org/10.1051/matecconf/202134204011
6. Jewell, J. (2011). "The IEA Model of Short-Term Energy Security (MOSES):Primary Energy Sources and Secondary Fuels", *IEA Energy Papers*, No. 2011/17, OECD Publishing, Paris. https://doi.org/10.1787/5k9h0wd2ghlv-en
7. Khan, N., Ullah, F U M., Haq, I U., Khan, S U., Lee, M Y., & Baik, S W. (2021, October 2). AB-Net: A Novel Deep Learning Assisted Framework for Renewable Energy Generation Forecasting. *Multidisciplinary Digital Publishing Institute*, 9(19), 2456-2456. https://doi.org/10.3390/math9192456
8. MAGDA, R., Bozsik , N., & Meyer, N. (2019). An evaluation of gross inland energy consumption of six Central European countries. *Journal of Eastern European and Central Asian Research* (JEECAR), 6(2), 270–281. https://doi.org/10.15549/jeecar.v6i2.29
9. Marcombe, A.-C., Sayfullaev, K., & Islamova, N. (2024). Redefining responsible consumption decent work: Insights from the second-hand industry in Uzbekistan. *Journal of Eastern European and Central Asian Research* (JEECAR), 11(3), 604–620. https://doi.org/10.15549/jeecar.v11i3.165
10. Meyer, N., Magda, R., & Bozsik, N. (2021). The role of renewable energies in the new EU member states. *Journal of Eastern European and Central Asian Research* (JEECAR), 8(1), 18–25. https://doi.org/10.15549/jeecar.v8i1.536
11. Safari, A., Das, N., Langhelle, O., Roy, J., & Assadi, M. (2019, June 7). Natural gas: A transition fuel for sustainable energy system transformation?. *Wiley*, 7(4), 1075-1094. https://doi.org/10.1002/ese3.380
12. Safarov, J., & Hasanov, R. (2024). Green production management in the aluminum industry: A sustainable approach towards environmental performance. *Journal of Eastern European and Central Asian Research* (JEECAR),11(1), 114–126. https://doi.org/10.15549/jeecar.v11i1.1415
13. Savelsberg, J., Schillinger, M., Schlecht, I., & Weigt, H. (2018, July 19). The Impact of Climate Change on Swiss Hydropower. *Multidisciplinary Digital Publishing Institute*, 10(7), 2541-2541. https://doi.org/10.3390/su10072541
14. Senderov, S., Yusifbeyli, N., Rabchuk, V., Huseynov, A., Nasibov, V., Guliyev, G., Vorobev, S., & Smirnova, E. (2018, January 1). Modern problems of energy security of the Caspian regions of Russia and Azerbaijan. *EDP Sciences*, 69, 01014-01014. https://doi.org/10.1051/e3sconf/2018690101
15. Yilmaz, S. (2017). Eurasian Economic Union: A Regional Economic Hegemony Initiative. *Journal of Eastern European and Central Asian Research* (JEECAR), 4(2), 15. https://doi.org/10.15549/jeecar.v4i2.16
16. Narmania, D., Chokheli, E., Kharkheli, M., Davitaia, S., Tordinava T., & Vardiashvili, N. (2024). Energy Accessibility: Strategies for Equitable Energy Access in Georgia. *Journal of. Electrical Systems* 20 (10s), 5963-5972. https://journal.esrgroups.org/jes/article/view/6532
17. Narmania, D., Chokheli, E., Kharkheli, M., Vardiashvili, N., Davitaia, S., Makasarashvili, M., & Morchiladze, G. (2025). Assessing Household Energy Expenditure Dynamics and Energy Availability in Georgia, *TEM Journal*, 13 (5).
18. Narmania, D., & Chokheli, E. (2018). *Efficiency management of public infrastructure*. Available 15th January 2024 at https://ir.kneu.edu.ua/server/api/core/bitstreams/6acdb9ab-7451-4e4b-aabc-4e3fb1541c19/
19. Yimere, A., & Assefa, E. (2021, May 18). Assessment of the Water-Energy Nexus under Future Climate Change in the Nile River Basin. *Multidisciplinary Digital Publishing Institute*, 9(5), 84-84. https://doi.org/10.3390/cli9050084
20. Zhorzholiani, T., Chokheli, E., & Adamadze, P. (2024). Challenges in Enhancing Job Satisfaction for Optimal Hospitality Performance: A Case Study of Chain Hotels in Georgia. In M. Bari, M. Soliman, & E. Alaverdov (Eds.), Shifts in Knowledge Sharing and Creativity for Business Tourism (pp. 1-16). *IGI Global Scientific Publishing*. https://doi.org/10.4018/979-8-3693-2619-0.ch001
21. Zhao, C., Zhang, H., Zeng, Y., Li, F., Liu, Y., Chen, Q., & Yuan, J. (2018, January 22). Total-Factor Energy Efficiency in BRI Countries: An Estimation Based on Three-Stage DEA Model. *Multidisciplinary Digital Publishing Institute*, 10(2), 278-278. https://doi.org/10.3390/su10010278