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Prithvi Narayan Shah Research Center
Directorate General of Military Training, Nepali Army
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Critical Thinking on the Energy Security of Nepal

Keshav Raj Panthee*

Abstract

Changing geopolitical scenarios with the emergence of new Asian tigers, China and India, and political conflicts (Russia-Ukraine; Israel-Palestine-Iran) are creating different impacts in different sectors of the world. The Russia-Ukraine war has again reminded us of the past energy crisis and raised concern over energy security. The spillover effect of war compelled the countries, mainly European countries and emerging big economies, to focus on alternative sources of energy like nuclear energy, and solar energy, as well as coal extraction. Small countries are always in a socio-economic trap due to fear of energy insecurity. The landlocked country Nepal has already faced an energy crisis and its economic impact. Such a crisis raises the question of energy independence and threats to national security, like economic security, border security, resource security, and so forth. In this context, the paper has tried to seek answers to the research question: "Is Nepal secure in the energy sector?" For this, the energy security index and energy security indicators are reviewed based on past research studies, and indicators for Nepal are determined. Indicators for the energy security of Nepal are selected as per the availability of data and suitability to Nepal. Secondary data are used for analyzing the overall scenario of energy security in Nepal. The findings showed that though the condition of energy poverty in Nepal has improved, the prevailing energy data and indicators showed challenges in energy security in Nepal.

Keywords: *Energy security indicator, national security, energy demand, defense*

Introduction

Energy as an economic good affects all sectors of the economy and daily human life (Panthee, 2022). The speed of development and advancement in human life has gradually intensified the issue of energy security, mainly after the 1970s (Nuttall & Manz, 2008). With the growing use of energy by industrialized economies, rising energy prices, global energy supply crises, and political conflicts led the concept of energy security to put it in top priority in the 21st century (Azzuni & Breyer, 2018). Past political conflicts (1973, 1990, 2014, 2022) have usually created energy crises (Żuk & Żuk, 2022). Different scenarios have indicated that energy could become a new polarizing factor in the global security system (Jonsson et al., 2009).

* Lecturer, Koteshwor Multiple Campus
Email ID : krpanthee@gmail.com

The definition of energy security has been found to be changing as per the intensification of the energy crisis in different time periods. It is primarily defined as the availability and access to energy resources: coal, oil, gas and electricity (Nuttall & Manz, 2008; Chester, 2010; International Energy Agency, 2023) without jeopardizing major national values and objectives (Yergin, 1988). It is the availability of energy at a price level that does not affect economic performance (Shah et al., 2019).

Nowadays scholars have often used it in a broader perspective, covering a wider range of indicators related to energy production, supply, diversification of energy sources, efficient use of energy, the environment, military use, and cybersecurity (Semenenko et al., 2021; Azzuni & Breyer, 2018).

Even after the declaration of a national energy crisis by the Nepali government in 2008 (Sovacool et al.,2013) and the slow growth of industrial output caused by the energy crisis (Ministry of Finance, 2013) hydropower sector development was not satisfactory till 2020. However, the problem of load shedding was solved by the good administrative management practice initiated by the Nepal Electricity Authority in 2017. Though Nepal started the sale of surplus electricity to the Indian market by 2021, the problem of stable electricity supply in all parts of the country is still a challenging one.

Geographical location and economic status of Nepal have always raised the issue of availability and access to energy resources, mainly fossil fuels and electricity. Though access to electricity has reached all over the country, a sustainable supply of energy is still a challenging task, and it is affecting the overall economy. So, amidst the growing concern for energy security across the world, this paper aims to expose the level of energy security in the Nepali perspective based on selected energy security indicators and raise concern for the energy security strategy in the defense sector.

Review of Literature

Indicators of Energy Security

World indexes of national security show that national security indexes mainly assume energy security from the point of view of consumption, and resources and production of energy are not found prioritized in the national security (Mara et al., 2022). However, international organizations and different research scholars have identified different types of energy security indicators.

The Index of U.S. Energy Security Risk is prepared by the Global Energy Institute by including 37 types of energy security risk under nine categories and four sub-indexes: geopolitical, economic, reliability, and environmental (Global Energy Institute, 2020). The data is available for the period 1970-2019.

The World Energy Trilemma Index presents the World Energy Council's comparative annual ranking of energy systems of 126 countries, including three dimensions: energy security, energy equity, and environmental sustainability of energy systems (World Energy Council, 2024). Data on this index has been available since 2010.

The 2023 Energy Transparency Index includes 124 indicators grouped into eight categories: balances, natural monopolies, supply, reliability and security, consumption, reporting, policy, and public authorities (DiXi Group, 2024). It includes the comparison of four countries (Georgia, Moldova, Romania, and Ukraine) and their progress as per each category in comparison to 2021.

Energy policies of China, Germany, and Russia indicate that improved energy efficiency, reduction in the vulnerability of the energy system, and power grid stability are the means to ensure energy security (Proskuryakova, 2018). Shah et al. (2019) analyzed the energy security indicators of South Asian countries for the period 2006-2017, including six parameters: energy dependency, GDP per capita, energy consumption per capita, electrification ratio, the share of renewable energy sources in electricity generation, and diversity in total primary energy supply. Bhutan was found to be the most energy-secured country, and the Maldives was found to be the least energy-secured country in the region. After Bhutan, India, Sri Lanka, Pakistan, Nepal, Bangladesh, and Afghanistan were found to be the most energy-secured countries, respectively

Dźwigol et al. (2019) viewed energy security as a component of the national security of the country by analyzing the macro-level indicators of energy independence. GDP per capita, production-export-import energy materials and products, energy intensity of production, and investment in energy-related economic activity were the major variables included to analyze energy independence (a component of energy security) of a country.

Azzuni and Breyer (2018) identified 15 dimensions of energy security and their parameters by reviewing the scientific publications covering the period 1971 to 2016. Availability, diversity, cost, location, technology and efficiency, timeframe, resilience, environment, health, literacy, culture, employment, policy, military, and cybersecurity were the derived energy security dimensions that are interdependent with each other. Analysis of these dimensions and their respective parameters reflects the level of energy security of the country.

Radovanović et al. (2017) developed an energy security index including six indicators (energy intensity, final energy consumption, energy dependency, GDP per capita, share of renewable and nuclear energy, and carbon intensity) for EU-28 countries. Azzuni and Breyer (2020) developed an energy security index including 15 dimensions, 50 parameters, and 78 indicators and showed the status of the country-level energy security index. All the values of each dimension were normalized and standardized to a percentage value so that the index is applicable globally. The energy security index for Nepal was derived as 47.5%.

Ang et al. (2015) did a survey of 104 energy security studies from 2001 to 2014 and found energy security definitions concentrated on mainly seven themes: availability, infrastructure, energy prices, societal effects, the environment, governance, and efficiency. The number of energy security indicators found ranged from a minimum of 1 to a maximum of 68.

A wide range of research studies conclude that energy security is concerned with the reliable and affordable supply of energy sources from the individual level to the national, regional, and international levels. So, the indicators of energy security differ across the region and country as per the state of the source and supply of energy services.

Energy Security and Military Defense

Energy security in the military sector denotes the capability of supplying a required level of energy power to major weapons systems, including transport means to communication infrastructure for conducting military operations (Samaras et al., 2019a). Chinese military struggle, defense cooperation, and other types of assistance in the Persian Gulf, Pakistan, Sri Lanka, and so forth have been viewed as "arms for oil" trade policy of China (Lin, 2008). Energy dependency of the European Union on Russia has raised the concern of energy security in the EU region, and it was predicted that the energy security issue will affect future Common

Security and Defense Policy (CSDP) missions and operations. Jenkins (2012) also found noticeable and varied impact of energy security issues on the British defense policy that led to an emphasis on securing energy resources through military action.

Samaras et al. (2019) analyzed the relationship between energy issues and defense planning. They showed how energy policy and energy technology influence the military mission objectives of the U.S. Department of Defense (DoD). The operational energy strategy of the U.S. DoD was found concentrated on strategic goals like "more fight, less fuel; more options, less risk; and more capability, less cost. Defense planning was concentrated on efficient use of energy services used for various purposes, from lighting and transport to defense installations.

Saritas and Burmaoglu (2016) studied how the changing characteristics of warfare are increasing energy consumption and their implications for military energy policy. Their findings indicate that trends in military energy patents reflect waves of energy-intensive periods in military research and development, spanning energy generation, storage, and transfer. Wireless energy transfer systems (such as power converter technologies) in military equipment, along with the use of renewable energy technologies, are being prioritized in military R&D. Based on the scenario matrix proposed by Saritas and Burmaoglu (2016), three stages of military energy transformation are suggested at three levels: main bases, operation bases, and individual soldiers.

Countries like Brazil are taking energy resources and energy infrastructures as a defense objective and have been put forward in the national defense policy (Silva & Teixeira Júnior, 2021). Energy infrastructures have been identified as the physical infrastructures that are needed from the generation of energy to the supply and storage of energy.

Energy Security and Nepal

The power trade agreement (PTA) between Nepal and India in 2014 ultimately opened the door for cross-border electricity trade in 2021 (Panthee & Noppradit, 2024). But the problem of energy security in terms of reliable year-round electricity supply has not become possible till today. There is heavy reliance of Nepal on fossil fuels, though the development of renewable energy sources is speeding up more than before.

Different scholars have studied the energy security issue of Nepal. Observation of the aftermath crisis of the earthquake of 2015 in Nepal by Herington and Malakar (2016) showed the temporal nature of energy poverty in Nepal. It means people are always vulnerable to energy insecurity, which might be created by natural disasters and political scenarios. Shakya et al. (2023) subnational and even company targets for net-zero emissions of CO2 in support of the Paris Climate Agreement goals of limiting the global average temperature increase within 1.5 °C by 2100. The challenges faced by developing countries in achieving net-zero emissions targets are, however, very prominent due to their common desire for rapid economic growth, improved socio-economic conditions, and greater climate resilience. In addition, this has to overcome many constraints related to the competitiveness, acceptability, and sustainability of proposed and planned low-carbon initiatives. It is thus very important to understand the economic and technical characteristics of net-zero emissions concepts and pathways. The constraints can best be addressed if actual and transparent co-benefits related to these initiatives are identified and reflected during their implementation. Here we employ the Low Emissions

Analysis Platform (LEAP showed the scenario of improvement of energy security indicators and energy equity in Nepal as a result of the net-zero carbon emission strategy.

Bhattarai et al. (2024) developed an energy security composite index of Nepal, including 21 indicators for the period 2011 to 2020. This index was found to be varying between 3.84 (2020) and 4.19 in 2016. It indicates that Nepal is strong enough in terms of energy sufficiency even in comparison to SAARC countries for the same period. Poudel (2021) suggests the implementation of the Asta-Ja framework, including balance between water, land, forest, medicinal and aromatic plants, manpower, animals, crop plants, and climate for ensuring energy security in Nepal. Causal loop diagrams developed by Panthee and Noppradit (2023) show how energy efficiency measures help to promote energy security as well as a sustainable environment. Energy efficiency practices like green production practices, development of energy management systems, policy intervention, and use of energy-efficient technologies ultimately lead to efficient use of energy.

Studies on the analysis of energy security in Nepal by the use of energy security indicators are found only in limited numbers. This paper has attempted to update and fulfill the knowledge gap on the energy security of Nepal based on the selected energy security indicators, which are different than those of Bhattarai et al. (2024) and Shakya et al. (2023). The study has tried to expose the possible level of future energy security based on the available secondary information.

Materials and Methods

This study follows an explanatory research design. This method is used to generate an idea or reason behind the occurrence of any phenomenon based on secondary sources of information. The main aim of using explanatory research design is to analyze the scenario of energy security based on the selected measurable variables. Energy security has been analyzed in the Nepali perspective by using the findings of the past research studies and available secondary data on energy during the period 1990 to 2023.Though various indicators and indexes have been proposed by different scholars (Shah et al., 2019; Dźwigol et al., 2019; Radovanović et al., 2017) for measuring energy security, the following indicators have been used for the analysis of energy security in Nepal as per the data availability.

Table 1. Energy security indicators

Energy security indicators	Source
Nature of energy sources used	Ministry of Finance, Government of Nepal
Import growth of petroleum products	Ministry of Finance, Government of Nepal
Increment of transmission line	Nepal Electricity Authority Reports
Energy intensity: used to measure energy used per unit of output and expressed as: Energy intensity level of primary energy (MJ/$2017PPP GDP)	World Bank: World Development Indicators (https://databank.worldbank.org/source/world-development-indicators)
Profit/loss on petroleum product sale and distribution	Nepal Oil Corporation
Electricity production, import, leakage, consumption and access	Ministry of Finance, Government of Nepal

The nature of energy sources used indicates the use of different types of energy sources in Nepal. The shift of energy consumption from petroleum products to electricity and other renewables indicates energy security in Nepal. Likewise, a high level of growth in the import of petroleum products indicates a high level of energy dependency. Energy intensity indicates the level of efficient use of available energy sources. A low value of energy intensity indicates that with less energy, more production is done. Profit/loss on the sale of petroleum products indicates the energy demand (petroleum products) capacity of a country at the time of high demand for energy for different purposes. An increment in the transmission line indicates the possibility of a stable supply of electricity and encourages investment in hydropower.

Results and Discussion

Like in many developing countries, there is the dominance of traditional energy sources in Nepal. However, over the selected years, there is a noticeable shift towards commercial energy sources. The share of traditional energy sources has declined from 94% in 1990 to 66% in 2020, and the share of commercial energy sources has reached about 32% in 2020 from about 6% in 1990 (Table 2). The role of electricity and other renewables has also been found to be increasing. The dominance of firewood and petroleum products in energy sources can contribute to greenhouse gas emissions.

Table 2. Percent share of type of energy sources in Nepal (1990-2020)

Year	Traditional Total	Firewood	Agriculture Residue	Cow dung cake	Commercial Total	Coal	Petroleum products	Electricity	Others/ Renewable
1990	94.05	83.99	3.78	6.27	5.89	0.71	4.33	0.84	0.07
1995	90.33	80.69	3.62	6.02	9.51	1.05	7.40	1.05	0.16
2000	85.80	76.30	3.76	5.75	13.77	3.18	9.23	1.36	0.43
2005	87.04	77.59	3.72	5.73	12.36	2.75	7.76	1.85	0.60
2010	83.70	74.90	3.26	5.54	15.56	2.89	10.42	2.26	0.74
2015	78.41	71.18	3.52	3.72	19.10	4.55	10.83	3.63	2.48
2020	66.33	60.44	3.01	2.87	31.62	9.62	17.81	4.19	2.06

Source: Author's calculation from the various issues of Economic Survey published by MOF, GoN.

Nepal imports petrol, diesel, kerosene, aviation turbine fuel, and LPG as the major petroleum products (Table 3). Except for kerosene, the growth of all other petroleum products has been found to be fluctuating on average around 10% to 16% during the period 1994 to 2021. Except in the year of the earthquake, i.e., in 2015, almost positive growth trends of all the petroleum products except kerosene have been observed. With the growth of the aviation industry, tourism demand for aviation fuel has been found to be increasing. Dependence on petroleum products and their growth is one of the major parts of energy security in Nepal, like that of other developed and developing countries.

Table 3. Import growth % of petroleum products in Nepal (1994-2021)

Year	Petrol (KL)	Diesel (KL)	Kerosene (KL)	Aviation Turbine Fuel (KL)	LPG (MT)
1994	11.26	16.65	9.02	24.47	40.19
1997	1.90	16.47	17.60	6.11	5.21
2000	9.15	1.94	-7.14	10.99	30.94
2003	-0.75	0.32	-10.97	20.26	17.94
2006	20.31	2.41	-14.41	-3.71	15.50
2009	26.90	24.29	-32.24	11.46	21.90
2012	10.18	10.35	-42.16	5.45	14.13
2015	-16.38	-14.76	-27.78	-40.72	-17.08
2018	15.99	7.93	11.94	1.46	15.94
2021	24.43	1.61	-26.48	117.44	12.20
Average growth for 1994-2021	12.76	9.37	-5.04	10.27	16.25

The transmission line, a major energy infrastructure required for the supply of electricity within Nepal and cross-border electricity trade, is in an increasing trend during the period 2014 to 2023. The increment of transmission line is found to be the highest in 2023 (766 ckt. km). It is a good sign for stable energy supply in Nepal.

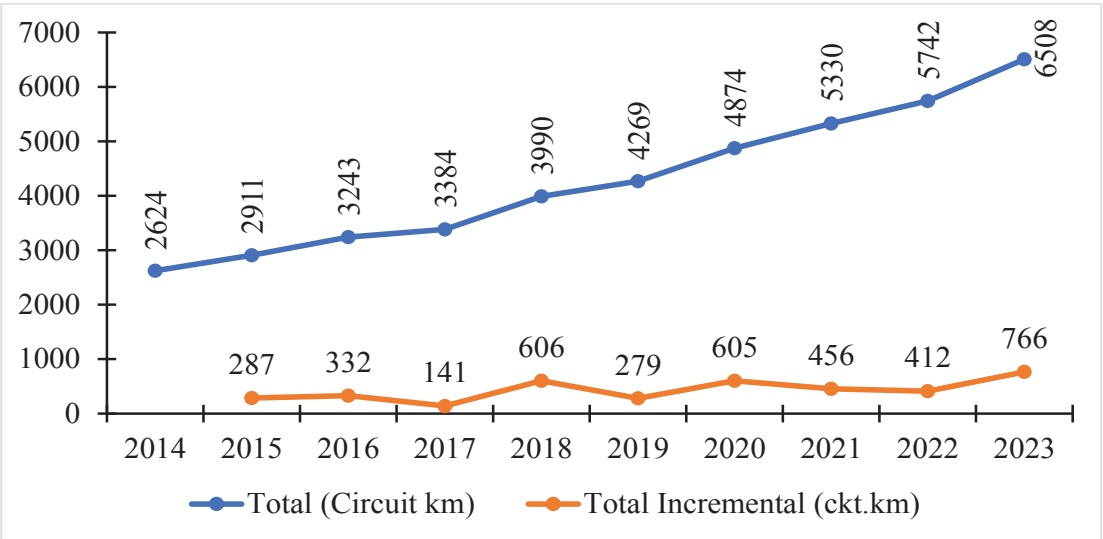


Figure1. Transmission line length (2014-2023)
Source: (Nepal Electricity Authority, 2022; Nepal Electricity Authority, 2024)

Energy intensity is widely used for measuring the level of energy efficiency. The level of energy intensity has been found to be around 6 during the last 10 years. It does not indicate the

significant improvement in energy efficiency in Nepal. Figure 2 shows the positive correlation between import growth and energy intensity, mainly after 2000. Due to the high level of import and use of petroleum products, the import of goods has not caused a decline in energy intensity. It also shows the possibility of the import of less energy-efficient technology for the production purpose.

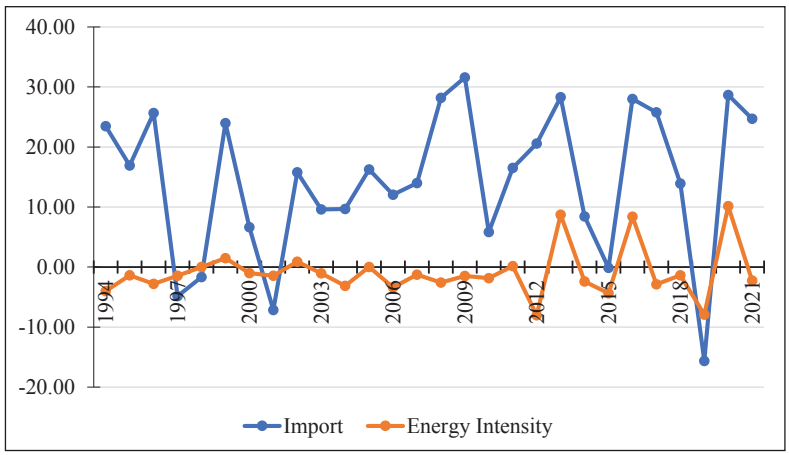


Figure 2. Growth % of Nepali import trade and energy intensity (1994-2021)
(Source: World Bank, 2024)

Figure 2 indicates that the expansion of exports hasn't contributed much to lowering the level of energy intensity. In other words, export growth has no significant impact on energy intensity. It might be due to a less energy-efficient productive sector (Panthee, 2022).

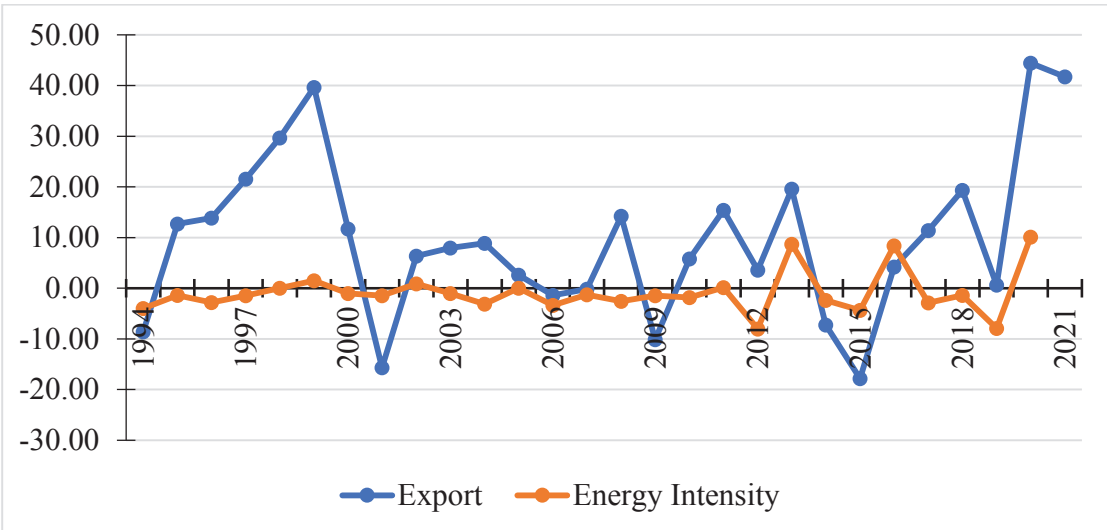


Figure 3. Growth % of Nepali export trade and energy intensity (1994-2021)
(Source: World Bank, 2024)

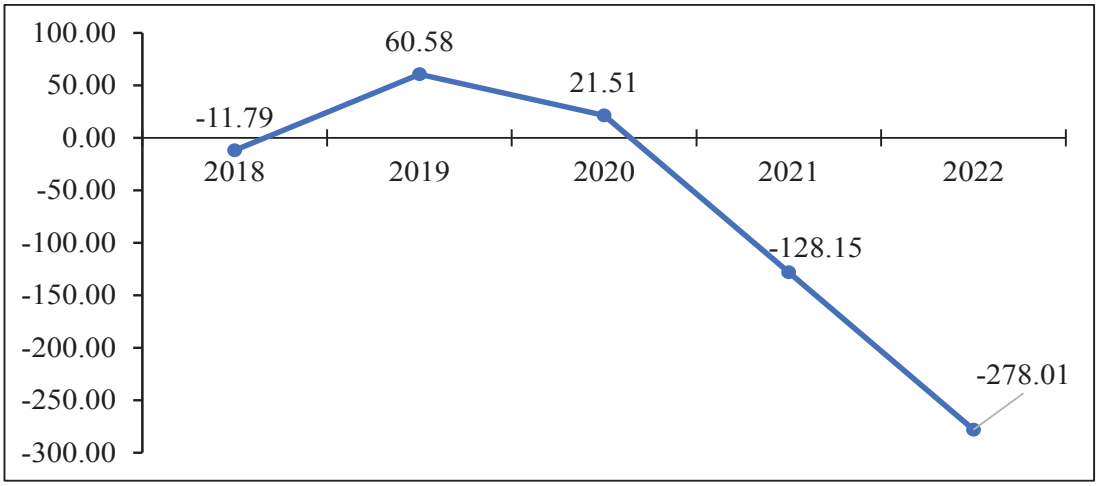


Figure 4. Average yearly profit/loss on petroleum products (NRs Crore)
Source: (Nepal Oil Corporation, 2024).

Average yearly loss on sale of petroleum products is found to be highly increasing along with the growth of petroleum products (Table 3). It demands the reduction of supply and distribution costs of petroleum products. Recently, since 2021, Nepal has been engaged in cross-border electricity trade, and it is supporting generating sales revenue for the Nepal Electricity Authority. However, the sales revenue is uncertain, and the bilateral electricity exchange price is found to be only around NRs. 8 on average during the period 2011 to 2022 (Figure 5).

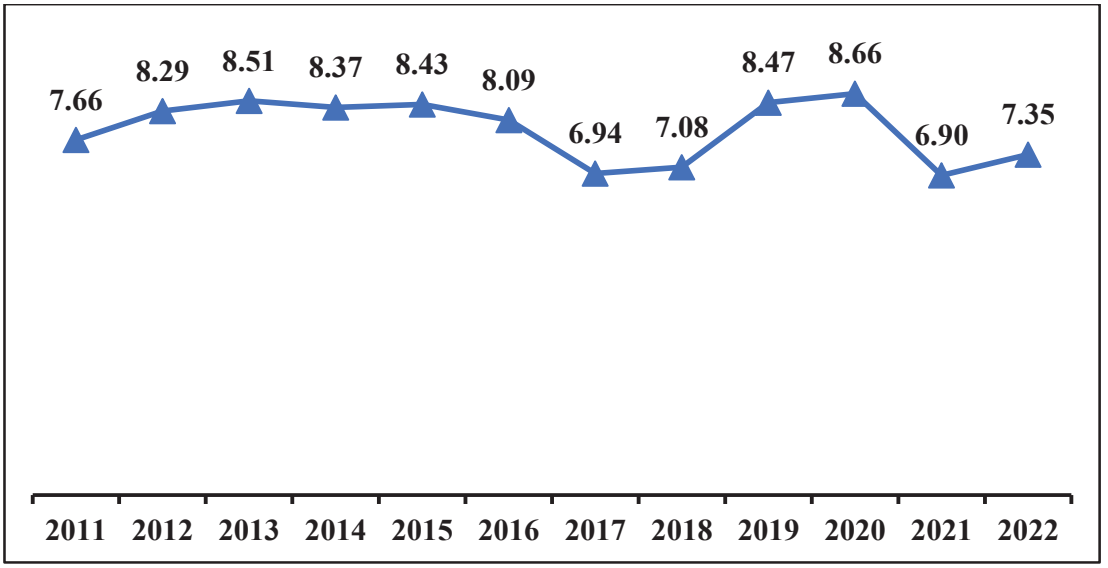


Figure 5. Indo-Nepal electricity exchange prices (NRs./kWh)
Source: (Panthee & Noppradit, 2024)

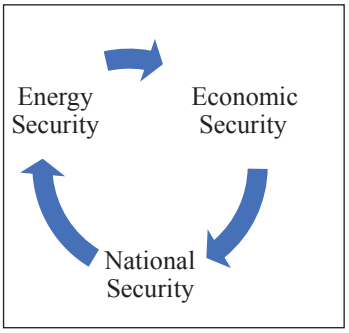
Table4. Electricity Production, import, leakage, consumption and access in Nepal (2014-2022)

Description	2014	2015	2016	2017	2018	2019	2020	2021	2022
Electricity Generation (MW)	829	856	972	1074	1182	1333	1451	2190	2684
Electricity import from India (GWh)	1370	1778	2175	2582	2813	1729	2826	1543	1854
Electricity Leakage (%)	24.4	25.8	22.9	20.5	15.3	15.3	17.2	15.4	13.5
Per capita electricity consumption (kwh)	133	131	164	198	233	240	246	304	380
Population with access to electricity (%)	61.9	63.2	68.3	74.5	78	86.4	89.7	92.5	95

Electricity generation, mainly driven by the Nepali hydropower sector, has been found to have significantly increased since 2020. However, the import of electricity from India is found to be fluctuating. It is due to regional demand-supply dynamics as well as less generation of electricity during the winter season. It shows the electricity dependency of Nepal on India due to inadequate generation of electricity in the domestic market. Electricity leakage has decreased from 24.4% in 2014 to 13.5% in 2022. Similarly, per capita electricity consumption is gradually increasing and has reached 380 kWh in 2022. The population having access to electricity has reached 95% in 2022. Though there is a bright sign of electricity consumption in Nepal, a stable supply of electricity is still a challenging part. But the correlation between Nepali HDI and energy equity during the period 2000 to 2022 (World Energy Council, 2024) shows the sign of improvement in energy poverty.

Discussion

Though Nepal is regarded as strong in terms of energy sufficiency (Bhattarai et al., 2024) this study may be novel to develop the Energy Security Composite Index of Nepal (ESCOIN). Energy security cannot be guaranteed until and unless sufficient electricity is generated and dependency on petroleum products is reduced. The present level of electricity generation does not guarantee the perspective energy security in Nepal. Long duration taken for the completion of mega hydropower projects and growing neighborhood concern is not allowing speeding up the hydroelectricity generation and distribution.



A major threat to energy security in Nepal is energy dependency, which is included in the energy security index and indicators by various scholars (Shah et al. (2019), Dźwigol et al. (2019), Radovanović et al. (2017)). But increased demand and growth of petroleum products, along with the increase in the tourism industry as well as growing concern for commercial use of energy, indicate that still for the coming decades there is not the possibility for reducing energy import dependency of Nepal. A low level of growth of manufacturing still shows the possibility of rising demand for energy, and in the present scenario, the domestic supply of

energy through electricity does not seem sufficient. Effective implementation of an energy efficiency strategy in Nepal should be given priority so that such dependency could be reduced in the future.

A low level of energy intensity indicates the requirement of less energy for the production of one unit of output. It supports increasing the level of energy efficiency by lowering the energy demand. However, the value of energy intensity is almost constant and fluctuating between 5 and 6 during the last 20 years. Both export and import trades are not found to lower energy intensity. For energy resource-deficient and energy-dependent countries, such indicators matter much.

The dominance of traditional sources of energy in the energy mix indicates the environmental concern as well in the form of carbon emissions. Due to less generation of energy through renewable energy sources, firewood, coal, and petroleum products consumption will dominate the Nepali energy market in the coming year. However, the increment and improvement in energy infrastructure, like that of transmission lines and petroleum pipelines, show hope for assuring a little bit of energy security in Nepal.

The cost of energy supply is a major challenge for Nepal due to its geographical nature. The growing loss of Nepal Oil Corporation for managing petroleum products, uncertainty in the revenue from the sale of electricity to India, electricity shortages during winter, and the import of electricity from India are major concerns for energy costs in Nepal. Cost-reducing measures have to be implemented for providing energy products at an affordable price in Nepal.

Economic, energy, and national security will all be closely intertwined in the years to come (Lin, 2008). The changing nature of security and warfare has dramatically increased the demand for energy for military operations (Saritas & Burmaoglu, 2016). Though this study did not find energy security-related research works in the Nepali security sector (defense sector) while reviewing scholarly articles, the review of foreign-based research works has made the environment think that the defense strategy of Nepal should also incorporate energy security. The Nepali Army can move ahead in this direction, like that of the initiation taken in environment-related issues.

Conclusion

The study has analyzed the energy security scenario of Nepal based on the secondary source of information and energy security indicators. The findings showed that the prevailing level of electricity access and energy supply is satisfactory. However, energy data as well as energy security indicators do not justify that Nepal is on the safe side from the perspective of energy security. So, reducing energy import dependency, energy cost, rapid expansion of transmission lines, and energy efficiency should be given top priority for ensuring energy security in Nepal. Growing energy concern by neighboring countries having a high level of economic growth in the present scenario shows both opportunities and challenges for the hydro resource-rich country Nepal. Due to its landlocked position, there is always a threat of an energy crisis in Nepal. The past energy crises compels us to think that energy security is a major concern for economic security and overall national security. Along with the general energy security concept, priority should be given to guaranteeing energy security in the Nepali defense sector. The Nepali Army can lead in this aspect.

References

Ang, B. W., Choong, W. L., & Ng, T. S. (2015). Energy security: definitions, dimensions and indexes. *Renewable and Sustainable Energy Reviews*, *42*, 1077–1093. https://doi.org/10.1016/j.rser.2014.10.064

Azzuni, A., & Breyer, C. (2018). Definitions and dimensions of energy security: a literature review. *Wiley Interdisciplinary Reviews: Energy and Environment*, *7*(1), 1–34. https://doi.org/10.1002/wene.268

Azzuni, A., & Breyer, C. (2020). Global energy security index and its application on national level. *Energies*, *13*(10), 20–25. https://doi.org/10.3390/en13102502

Bhattarai, U., Maraseni, T., Devkota, L., & Apan, A. (2024). A composite indicator-based method to assess the energy security of Nepal and prospects of cross-border electricity sharing in South Asia. *Environmental Development*, *51*, 101002. https://doi.org/10.1016/j.envdev.2024.101002

Chester, L. (2010). Conceptualising energy security and making explicit its polysemic nature. *Energy Policy*, *38*(2), 887–895. https://doi.org/10.1016/j.enpol.2009.10.039

DiXi Group. (2024). Energy transparency index. (*3rd Ed*.). https://doi.org/10.35562/alyoda.9095

Dźwigol, H., Dźwigoł-Barosz, M., Zhyvko, Z., Miśkiewicz, R., & Pushak, H. (2019). Evaluation of the energy security as a component of national security of the country. *Journal of Security and Sustainability Issues*, *8*(3), 307–317. https://doi.org/10.9770/jssi.2019.8.3(2)

Global Energy Institute. (2020). *Index of U.S. energy security risk: Assessing America's vulnerabilities in a global energy market*. https://www.uschamber.com/assets/documents/globalenergyinstitute-usindex_web.pdf

Herington, M. J., & Malakar, Y. (2016). Who is energy poor? Revisiting energy (in) security in the case of Nepal. *Energy Research and Social Science*, *21*, 49–53. https://doi.org/10.1016/j.erss.2016.06.025

Jenkins, B. (2012). *How did concepts of energy security and sustainable security affect British defence policy between 1997 and 2010?* http://www.swansea.ac.uk/library/researchsupport/ris-support/

Jonsson, D. K., Östensson, M., Dreborg, K. H., & Magnusson, R. (2009). Energy and Security in Long-Term Defence Planning: Scenario Analysis for the Swedish Armed Forces. *European Security*, *18*(1), 33–54. https://doi.org/10.1080/09662830903432607

Lin, C. Y. (2008). Militarisation of China' s energy security policy–Defence cooperation and WMD proliferation along its string of pearls in the Indian Ocean. *Denkwurdigkeiten, Journal Der Politisch-Militarischen Gesellschaft*, *45*, 1–11. http://digilib.lib.unipi.gr/ket/bitstream/ket/788/1/Lin.pdf

Mara, D., Nate, S., Stavytskyy, A., & Kharlamova, G. (2022). The Place of energy security in the national security framework: An Assessment Approach. *Energies*, *15*(2). https://doi.org/10.3390/en15020658

Ministry of Finance (2013). *Economic Survey (FY 2012/13)*. Government of Nepal.

Nepal Electricity Authority. (2022). *Annual Report 2021/22*. https://nea.org.np/annual_report

Nepal Electricity Authority. (2024). *Nepal Electricity Authority: A year in review*.

Nepal Oil Corporation (2024). Fifteen days estimated profit/loss. https://noc.org.np

Nuttall, W. J., & Manz, D. L. (2008). A new energy security paradigm for the twenty-first century. *Technological Forecasting and Social Change*, *75*(8), 1247–1259. https://doi.org/10.1016/j.techfore.2008.02.007

Panthee, K. R. (2022). *Linking energy intensity with trade and CO_2 intensity through SMEs: An analysis of Nepal*. Prince of Songkla University, Thailand.

Panthee, K. R., & Noppradit, P. (2023). Promoting energy efficiency through SMEs: System dynamics approach. *International Journal of Energy, Environment, and Economics*, *30*(3), 277–294.

Panthee, K. R., & Noppradit, P. (2024). Indo-Nepal electricity trade: opportunities and challanges. In K. R. Panthee & A. Shrivastav (Eds.), *International seminar on international relations: Nepal and the world order* (First, Vols. 274–285, pp. 6–14). Neeti Anusandhan Pratishthan, Nepal.

Poudel, D. D. (2021). Asta-Ja and Energy Security in Nepal. *Strategic Planning for Energy and the Environment*, *40*(2), 95–120. https://doi.org/10.13052/spee1048-4236.4021

Proskuryakova, L. (2018). Updating energy security and environmental policy: Energy security theories revisited. *Journal of Environmental Management*, *223*(May), 203–214. https://doi.org/10.1016/j.jenvman.2018.06.016

Radovanović, M., Filipović, S., & Pavlović, D. (2017). Energy security measurement – A sustainable approach. *Renewable and Sustainable Energy Reviews*, *68*, 1020–1032. https://doi.org/10.1016/j.rser.2016.02.010

Samaras, C., Nuttall, W. J., & Bazilian, M. (2019a). Energy and the military: Convergence of security, economic, and environmental decision-making. *Energy Strategy Reviews*, *26*(2017). https://doi.org/10.1016/j.esr.2019.100409

Samaras, C., Nuttall, W. J., & Bazilian, M. (2019b). Energy and the military: Convergence of security, economic, and environmental decision-making. *Energy Strategy Reviews*, *26*(January), 100409. https://doi.org/10.1016/j.esr.2019.100409

Saritas, O., & Burmaoglu, S. (2016). Future of sustainable military operations under emerging energy and security considerations. *Technological Forecasting and Social Change*, *102*, 331–343. https://doi.org/10.1016/j.techfore.2015.08.010

Semenenko, O., Solomitsky, A., Onofriichuk, P., Chernyshova, I., Skurinevska, L., & Pekuliak, R. (2021). Methodical Approach to Assessing Level of the State Energy Security and Its Influence on the National Security and Economy of the Country. *Scientific Horizons*, *24*(4), 90–96. https://doi.org/10.48077/SCIHOR.24(4).2021.90-96

Shah, S. A. A., Zhou, P., Walasai, G. D., & Mohsin, M. (2019). Energy security and environmental sustainability index of South Asian countries: A composite index approach. *Ecological Indicators*, *106*(66), 105507. https://doi.org/10.1016/j.ecolind.2019.105507

Shakya, S. R., Nakarmi, A. M., Prajapati, A., Pradhan, B. B., Rajbhandari, U. S., Rupakheti, M., & Lawrence, M. G. (2023). Environmental, energy security, and energy equity (3E) benefits of net-zero emission strategy in a developing country: A case study of Nepal. *Energy Reports*, *9*, 2359–2371. https://doi.org/10.1016/j.egyr.2023.01.055

Silva, H. I. de P., & Teixeira Júnior, A. W. M. (2021). Securitized referent objects in Brazilian defence documents: Natural resources, critical infrastructure and energy security. *Contexto Internacional*, *43*(1), 77–98. https://doi.org/10.1590/s0102-8529.2019430100004

Sovacool, B. K., Dhakal, S., Gippner, O., & Jain Bambawale, M. (2013). Peeling the energy pickle: expert perceptions on overcoming Nepal's electricity crisis. *South Asia: Journal of South Asian Studies, 36*(4), 496-519.

World Energy Council. (2024). *World Energy Trilemma 2024: Evolving with Resilience and Justice*. 1–92. https://trilemma.worldenergy.org

World Bank, (2024). *World development indicators*. https://databank.worldbank.org/source/world-development-indicators

Yergin, D. (1988). Energy security in the 1990s. *Foreign Affairs*, *67*(1), 110. https://doi.org/10.2307/20043677

Żuk, P., & Żuk, P. (2022). National energy security or acceleration of transition? Energy policy after the war in Ukraine. *Joule*, *6*(4), 709–712. https://doi.org/10.1016/j.joule.2022.03.009

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