Journal of Economics and Economic Policy
Homepage: https://ijec.antispublisher.com/index.php/IJEC/index
Email: admin@antispublisher.com

e-ISSN : 3047-4892
IJECEP, Vol. 2, No. 3, July 2025
Page 239-247

Financing Energy Infrastructure for the AI Economy: LNG Exports, Grid Expansion, and Data Center Power Demand

Rifah Tasnia[1*]
[1] Master of Business Administration, Pennsylvania State University, University Park, USA

DOI: https://doi.org/10.61796/ijecep.v2i3.125

Sections Info

Article history:
Submitted: March 28, 2025
Final Revised: April 5, 2025
Accepted: April 20, 2025
Published: April 29, 2025

Keywords:
Artificial intelligence
Energy infrastructure financing
Data center power demand
Grid expansion
Renewable energy integration

ABSTRACT

Objective: *The accelerated adoption of artificial intelligence (AI) technology has resulted in greater energy consumption by data centers, thereby posing new financial problems regarding the construction of reliable and sustainable energy infrastructure.* ***Method:*** *This is a quantitative study employing an online questionnaire survey among 155 individuals based in the United States belonging to the fields of energy, AI, finance, government, and academia. Statistical analysis including descriptive statistics, Pearson's correlation, and multiple linear regression was performed on the collected data using IBM SPSS Statistics 27.* ***Results:*** *The variable of Energy Infrastructure Financing received the highest mean score (4.31), while Data Center Power Demand scored second (4.24). It was found that Grid Expansion was rated as the top priority for investments by 87.1% of the survey participants. Correlation analysis revealed the highest correlation between Energy Infrastructure Financing and Data Center Power Demand (r = 0.701). The results of regression analysis proved that Data Center Power Demand (β = 0.325), AI Economy Growth (β = 0.281), Grid Expansion (β = 0.268), LNG Export Investment (β = 0.214), and Renewable Energy Integration (β = 0.172) were significant factors influencing the process of financing. The high explanatory power of the regression model was confirmed by* $R^2 = 0.716$. ***Novelty:*** *It is necessary to use combined strategies of investment that will include modernization of the grid infrastructure, diversification of energy sources, and using renewable energy in order to cope with the electricity needs due to artificial intelligence.*

INTRODUCTION

The emergence of artificial intelligence (AI) is causing changes in the world economy through faster development of digital solutions, industrial automation, cloud computing, and complex data analytics [1]. The growing use of artificial intelligence tools causes a significant rise in the need for computer power which, in turn, provokes unprecedented growth of data centers and high performance computing infrastructures [2]. The development of such technologies necessitates stable and continuous electricity supply which makes energy infrastructure an integral part of the strategy of supporting the development of the economy due to artificial intelligence technologies [3]. Along with the expansion of digital industry sectors, governments and investors give priority to energy infrastructure projects that will allow sustaining economic competitiveness and energy security by providing electricity in the long run [4]. There appears great pressure on electricity infrastructures because of the expansion of AI infrastructure. Data centers consume much electricity for computing, cooling, and constant operation [5]. As a result, financing energy infrastructure has become a key policy and investment challenge. Grid extension will improve the ability to transmit and distribute power and will increase the reliability of the system, whereas investments in LNG export facilities will increase energy fuel availability and flexibility in energy generation during peak power demands [6]. At the same time, renewable energy integration can contribute to the production of cleaner electricity and sustainable energy systems for the development of AI industries [7].

It has been shown in recent research that investments in energy infrastructure contribute not only to higher energy security but also to economic growth, technological innovation, and increased productivity of industries [8]. Power infrastructure creates incentives for private investments, lures technology companies, and helps to develop AI industries. Furthermore, better infrastructure means lower risks of power outage and higher resilience of energy systems [9]. Since AI implementation becomes widespread in such sectors as manufacturing, medicine, finance, transport, and IT services, the demand for electricity will continue growing [10]. While there is an increased awareness of the impact of AI and energy transition, there is limited empirical research that evaluates stakeholders' perceptions about the interactions of the investments made in the export of LNG, grid expansion, use of renewable energy, and rising data center power requirements in energy infrastructure financing [11], [12]. Most of the literature tends to focus on each factor alone, leaving limited information about the impacts of these interactions within a common framework. It is imperative to have knowledge of the interactions of the factors to create investment strategies that will promote growth of the AI economy while at the same time building reliable energy systems [13].

This study will investigate the interaction of Energy Infrastructure Financing, LNG Export Investment, Grid Expansion, Data Center Power Demand, AI Economy Growth, and Renewable Energy Integration through a questionnaire involving 155 individuals. The Pearson correlation analysis and multiple linear regression will be used to evaluate the impact of the factors in the financing decision. The results will be instrumental to policymakers, infrastructure developers, energy financiers, and other stakeholders in creating energy infrastructure that promotes economic development and energy security of the AI economy.

MATERIALS AND METHODS

Study Design and Data Collection

In this study, a quantitative cross-sectional research methodology was applied in order to examine the factors that affect the financing of energy infrastructure in the age of the AI economy. For primary data, an online questionnaire was distributed among the professionals operating in the energy, AI, finance, government, and educational fields of the United States of America. Convenience and professional network sampling methodologies were utilized to identify relevant participants [14]. In all, 180 questionnaires were sent out via email, with 155 complete answers being regarded as valid responses, representing a response rate of 86.1%. Participation in the study was completely voluntary and anonymous, following an informed consent process.

Questionnaire Design and Variable Measurement

This questionnaire design was influenced by a literature review of the studies already carried out on energy infrastructure financing, LNG export investments, electricity consumption for AI and sustainable energy development. This questionnaire had two parts; one with demographic data and the other with measuring questions [15]. The respondents answered each question using a five-point Likert scale whereby 1 represented Strongly Disagree while 5 represented Strongly Agree. The dependent variable in this study was Energy Infrastructure Financing (EIF) [16]. The independent variables included; LNG Export Investment (LEI), Grid Expansion (GE), Data Center Power Demand (DCPD), AI Economy Growth (AIEG) and Renewable Energy Integration (REI) [17].

Statistical Analysis

Statistical analysis of data was carried out using IBM SPSS Statistics version 27. Frequencies, percentages, means, standard deviations, variances, skewness, and kurtosis for descriptive statistics were used to give summaries of respondent demographics and the distributions of the study variables [18]. Correlation analysis was done using Pearson correlation to find the strength and direction of linear associations between the variables [19]. Afterward, multiple regression analysis was used to analyze the impact of the independent variables on Energy Infrastructure Financing (EIF) [20]. The multiple regression model was tested using R^2, Adjusted R^2, F-test, Durbin-Watson statistic, and VIF. Statistical significance was set at $p < 0.05$ while the confidence level of all analyses was set at 95% [21], [22]. The multiple linear regression equation is: where EIF represents Energy Infrastructure Financing, β_0 is the intercept, β_1–β_5 are the regression coefficients, and ε denotes the random error term. Pearson's correlation coefficient was computed using:

$$r = \frac{\sum_{i=1}^{n}(X_i - \bar{X})(Y_i - \bar{Y})}{\sqrt{\sum_{i=1}^{n}(X_i - \bar{X})^2 \sum_{i=1}^{n}(Y_i - \bar{Y})^2}}$$

where r indicates the magnitude and direction of the linear relationship between two continuous variables.

RESULTS

Demographic Characteristics of Respondents

The demographic variables of the 155 respondents are illustrated in **Table 1.** The sample was mainly comprised of males (65.8%), and the female part comprised only 34.2%, thus showing more active involvement of men in the professional life of energy and AI spheres. The most numerous age group was the one of the 35–44-year-olds (36.8%), followed by 45-54 years old (27.1%), thus showing that the survey mainly collected views of mid-aged and older people with a good experience in their industry. With regard to education, the respondents were well-educated, as 49.0% of them had a master's degree, and 24.5% - a doctoral degree, which means that the respondents had enough knowledge for evaluating the complicated issue of energy infrastructure. The most numerous occupation sector was the one related to the energy industry (27.7%), followed by AI/data centers (20.0%). Moreover, 31.6% of respondents had 5-10 years of professional experience, and 27.7% - 11-15 years of it.

Descriptive Statistics of the Study Variables

The descriptive statistics for the variables in the study as presented in **Table 2.** Energy Infrastructure Financing obtained the highest mean value (4.31), signifying that there is high favorability towards increased investments in energy infrastructure systems due to the rising needs of the AI economy. The high mean value was followed by Data Center Power Demand (4.24) and AI Economy Growth (4.18), which are recognized to have high electricity needs due to advancements in AI technology. The next highest rated variables include Investment Confidence (4.15), LNG Export Investment (4.12), and Energy Security (4.09). Though Grid Expansion had the lowest mean value (4.05), it was still higher than the neutral value.

Energy Infrastructure Financing and AI-Driven Power Demand

The strategic factors related to financing of energy infrastructure and AI-driven electricity demand have been viewed by the respondents as presented in **Figure 1.** Grid Expansion has been viewed as the most important factor since it got the highest level of agreement, which is 87.1%. This means that the necessity of further grid expansion will help in meeting electricity demands and increase the capacity of transmission. The other factors such as AI Economy Growth (82.6%) and Energy Infrastructure Financing (78.1%) got quite a high level of support from the respondents, which is due to the necessity to continue investing in sustaining development based on AI technology. Moreover, Data Center Power Demand (74.8%) has been recognized as the factor which increases the electricity demands.

Benefits of Energy Infrastructure Investment for the AI Economy

The survey respondents see the main advantages of energy infrastructure investments to the AI economy as an illustration in **Figure 2.** Grid Reliability gained the most agreement among the respondents (84.5%), highlighting the significance of having reliable grid reliability as the cornerstone of stability of electricity provision to industries in the AI sector. Economic Growth (81.3%) and AI Competitiveness (79.4%) gained high levels of agreement, suggesting that respondents view infrastructure investments as a driver of technological advancements and development. Energy Security gained 76.8% agreement among respondents, whereas Employment Creation gained 72.9% agreement among respondents, showing their understanding of the wider social and economic implications of the investments.

Pearson Correlation Matrix of the Study Variables

The correlation matrix based on the Pearson correlations between the study variables as reveals **Figure 3.** All correlation values were positive meaning that higher scores in one variable were positively correlated with better scores in other constructs. The highest correlation value was found between Energy Infrastructure Financing and Data Center Power Demand (r = 0.701), and then between Data Center Power Demand

and AI Economy Growth ($r = 0.692$), illustrating the tight link between AI expansion and energy investments. Energy Infrastructure Financing had high correlation with AI Economy Growth ($r = 0.674$) and LNG Export Investment ($r = 0.642$). Renewable Energy Integration was moderately positively correlated with all study variables with the highest correlation value to Grid Expansion ($r = 0.656$). As all correlations were less than 0.80, the absence of multicollinearity among study variables can be concluded.

Multiple Linear Regression Analysis

The results of multiple linear regression analysis with regard to factors related to Energy Infrastructure Financing in contains **Table 3.** All predictor variables had statistically significant results ($p < 0.001$) which proves their significant contribution into the regression model. Data Center Power Demand had the highest level of impact on the model ($\beta = 0.325$), followed by AI Economy Growth ($\beta = 0.281$) and Grid Expansion ($\beta = 0.268$). These factors play an important role in investment decision-making process. Positive relationship between the independent and dependent variables is observed for LNG Export Investment ($\beta = 0.214$) and Renewable Energy Integration ($\beta = 0.172$). Moreover, the model has high predictability ($R = 0.846$; $R^2 = 0.716$; Adjusted $R^2 = 0.706$), meaning that 71.6% of variation of Energy Infrastructure Financing can be explained with the help of chosen predictors. Additionally, the Durbin-Watson statistics (2.07) and low VIF values prove model reliability and lack of multi-collinearity.

Discussion

The current study shows how the finance of energy infrastructure is significantly affected by the fast growth of the AI economy and related electricity demands. The respondents showed their support for Energy Infrastructure Financing (mean = 4.31) and Data Center Power Demand (mean = 4.24), thus admitting that today's power networks need considerable investment to facilitate the digital transformation enabled by AI technologies. As a result of the increasing use of cloud computing, supercomputing, and AI-related applications, the electricity generation and supply networks face an unprecedented strain [23]. Therefore, both governmental and private actors should consider investing in the infrastructure that will increase the resilience of power networks and ensure uninterrupted electricity supplies to the new digital industries [24].

Grid expansion was also recognized as one of the important factors affecting the future development of energy investments [25]. While the average score of its importance did not exceed moderate, still 87.1% of survey participants recognized the importance of grid expansion for future electricity generation. Modern electricity networks have to be constantly upgraded in order to increase their transmission capacity and reliability because of increasing AI-related electricity consumption [26]. Grid infrastructure expansion helps in incorporating additional electricity sources in the network and increases system flexibility in case of peak loads. Consequently, strategies of transmission modernization will help to ensure reliability of electricity generation as well as decrease operational risks due to the growing digital infrastructure [27]. Thus, these results confirm previous studies emphasizing the importance of grid modernization in order to have reliable electricity generation systems.

Moreover, the statistics show that rising electricity demand created by the AI infrastructure plays the role of the most influential variable in determining investment decision-making. Data Center Power Demand was the variable that had the strongest positive correlation with Energy Infrastructure Financing ($r = 0.701$), as well as the variable with the biggest standardized regression coefficient ($\beta = 0.325$). This shows that the growing number of data centers is seen by stakeholders as one of the main factors stimulating investment in electricity infrastructure. AI Economy Growth showed a strong positive correlation, stressing the strong connection between innovation and future electricity demands [28]. With the rise in AI adoption in manufacturing, healthcare, finance, transport, and technology, the electricity demands will grow further [29]. Therefore, it should be planned together with the growth of electricity generation and transmission capacities.

Additionally, the variables of LNG Export Investment and Renewable Energy Integration had a positive contribution towards the financing decisions. This shows that the respondents tend to pursue an energy investment policy that is diversified in nature rather than investing in one source of energy. Even though LNG infrastructure enhances fuel accessibility and the reliability of electricity in times of high demand, renewable energy integration helps in achieving environmental sustainability and reduces carbon emissions linked with electricity production [30]. Regression analysis was able to explain a significant portion of variability of the dependent variable of Energy Infrastructure Financing ($R^2 = 0.716$). Moreover, the Durbin-Watson test was found to be 2.07 showing that the estimated regression equation was robust enough. In conclusion, it seems apparent that the future investment policies need to focus on the combination of all these factors in order to create sustainable energy systems.

CONCLUSION

Fundamental Finding: The study shows that the following factors affect the financing of Energy Infrastructure: Data Center Electricity Consumption, Artificial Intelligence Economy Development, Grid Expansion, LNG Export Investments, and Renewable Energy Sources Integration. **Implication**: From the results, one can conclude that the balanced development of electricity production, transmission infrastructures, and energy sources plays a key role in financing the growing artificial intelligence economy. Improvements in sustainable and resilient energy systems will lead to improvements in electricity reliability, energy security, investment attractiveness, and sustainable economic development. **Limitation:** This study is limited by its focus on selected factors affecting energy infrastructure financing, including data center electricity consumption, artificial intelligence economy development, grid expansion, LNG export investments, and renewable energy integration. Other potentially influential factors, such as government policies, energy prices, financing costs, technological changes, and regional differences, may not be fully captured. In addition, variations in energy infrastructure conditions across countries or regions may limit the generalizability of the findings. **Future research:** should incorporate additional economic, technological, regulatory, and environmental factors to provide a more comprehensive understanding of energy infrastructure financing for the growing AI economy. Further studies could compare different countries or regions to identify variations in financing requirements and infrastructure readiness. Longitudinal research is also recommended to examine how increasing AI and data center electricity demand affects grid investment, renewable energy integration, energy security, and sustainable economic development over time.

REFERENCES

[1] G. Bridge and M. Bradshaw, "Making a global gas market: Territoriality and production networks in liquefied natural gas," *Economic Geography*, vol. 93, no. 3, pp. 215–240, 2017, doi: 10.1080/00130095.2017.1283212.

[2] A. Safari, N. Das, O. Langhelle, J. Roy, and M. Assadi, "Natural gas: A transition fuel for sustainable energy system transformation?" *Energy Science & Engineering*, vol. 7, no. 4, pp. 1075–1094, 2019, doi: 10.1002/ese3.380.

[3] M. Di Castelnuovo and A. Biancardi, "The future of energy infrastructure," in *Future of Business and Finance*, Cham: Springer, 2020, pp. 5–52, doi: 10.1007/978-3-030-44667-3_2.

[4] S. Kim, "Hybridized industrial ecosystems and the makings of a new developmental infrastructure in East Asia's green energy sector," *Review of International Political Economy*, vol. 26, no. 1, pp. 158–182, 2019, doi: 10.1080/09692290.2018.1554540.

[5] W. Hao, S. M. A. Shah, A. Nawaz, A. Asad, S. Iqbal, H. Zahoor, and A. Maqsoom, "The impact of energy cooperation and the role of the One Belt and Road Initiative in revolutionizing the geopolitics of energy among regional economic powers: An analysis of infrastructure development and project management," *Complexity*, vol. 2020, pp. 1–16, 2020, doi: 10.1155/2020/8820021.

[6] C. Hepburn, Y. Qi, N. Stern, B. Ward, C. Xie, and D. Zenghelis, "Towards carbon neutrality and China's 14th Five-Year Plan: Clean energy transition, sustainable urban development, and investment priorities," *Environmental Science and Ecotechnology*, vol. 8, p. 100130, 2021, doi: 10.1016/j.ese.2021.100130.

[7] D. Von Hippel, R. Gulidov, V. Kalashnikov, and P. Hayes, "Northeast Asia regional energy infrastructure proposals," *Energy Policy*, vol. 39, no. 11, pp. 6855–6866, 2009, doi: 10.1016/j.enpol.2009.08.011.

[8] S. Siddiqui, K. Vaillancourt, O. Bahn, N. Victor, C. Nichols, C. Avraam, and M. Brown, "Integrated North American energy markets under different futures of cross-border energy infrastructure," *Energy Policy*, vol. 144, p. 111658, 2020, doi: 10.1016/j.enpol.2020.111658.

[9] Y. Kim, "Asian LNG market changes under low oil prices: Prospects for trading hubs and a new price index," *Geosystem Engineering*, vol. 20, no. 3, pp. 129–141, 2016, doi: 10.1080/12269328.2016.1240046.

[10] S. Mujiyanto and G. Tiess, "Secure energy supply in 2025: Indonesia's need for an energy policy strategy," *Energy Policy*, vol. 61, pp. 31–41, 2013, doi: 10.1016/j.enpol.2013.05.119.

[11] W. Strielkowski, L. Civín, E. Tarkhanova, M. Tvaronavičienė, and Y. Petrenko, "Renewable energy in the sustainable development of electrical power sector: A review," *Energies*, vol. 14, no. 24, p. 8240, 2021, doi: 10.3390/en14248240.

[12] T. Van De Graaf, I. Overland, D. Scholten, and K. Westphal, "The new oil? The geopolitics and international governance of hydrogen," *Energy Research & Social Science*, vol. 70, p. 101667, 2020, doi: 10.1016/j.erss.2020.101667.

[13] J. Fritsch and R. Poudineh, "Gas-to-power market and investment incentive for enhancing generation capacity: An analysis of Ghana's electricity sector," *Energy Policy*, vol. 92, pp. 92–101, 2016, doi: 10.1016/j.enpol.2016.01.034.

[14] N. Norouzi, "Post-COVID-19 and globalization of oil and natural gas trade: Challenges, opportunities, lessons, regulations, and strategies," *International Journal of Energy Research*, vol. 45, no. 10, pp. 14338–14356, 2021, doi: 10.1002/er.6762.

[15] M. Y. Raza, M. Wasim, and M. S. Sarwar, "Development of renewable energy technologies in rural areas of Pakistan," *Energy Sources, Part A: Recovery, Utilization, and Environmental Effects*, vol. 42, no. 6, pp. 740–760, 2019, doi: 10.1080/15567036.2019.1588428.

[16] B. K. Singh, "South Asia energy security: Challenges and opportunities," *Energy Policy*, vol. 63, pp. 458–468, 2013, doi: 10.1016/j.enpol.2013.07.128.

[17] A. B. Stambouli, "Promotion of renewable energies in Algeria: Strategies and perspectives," *Renewable and Sustainable Energy Reviews*, vol. 15, no. 2, pp. 1169–1181, 2010, doi: 10.1016/j.rser.2010.11.017.

[18] B. H. Bowen, D. Canchi, V. A. Lalit, P. V. Preckel, F. Sparrow, and M. W. Irwin, "Planning India's long-term energy shipment infrastructures for electricity and coal," *Energy Policy*, vol. 38, no. 1, pp. 432–444, 2009, doi: 10.1016/j.enpol.2009.09.033.

[19] Y. L. Zhukovskiy, D. E. Batueva, A. D. Buldysko, B. Gil, and V. V. Starshaia, "Fossil energy in the framework of Sustainable Development: Analysis of prospects and development of forecast scenarios," *Energies*, vol. 14, no. 17, p. 5268, 2021, doi: 10.3390/en14175268.

[20] X. Chen, Z. Li, K. P. Gallagher, and D. L. Mauzerall, "Financing carbon lock-in in developing countries: Bilateral financing for power generation technologies from China, Japan, and the United States," *Applied Energy*, vol. 300, p. 117318, 2021, doi: 10.1016/j.apenergy.2021.117318.

[21] M. Bazilian, B. Sovacool, and T. Moss, "Rethinking energy statecraft: United States foreign policy and the changing geopolitics of energy," *Global Policy*, vol. 8, no. 3, pp. 422–425, 2017, doi: 10.1111/1758-5899.12461.

[22] S. S. Priya, E. Cuce, and K. Sudhakar, "A perspective of COVID 19 impact on global economy, energy and environment," *International Journal of Sustainable Engineering*, vol. 14, no. 6, pp. 1290–1305, 2021, doi: 10.1080/19397038.2021.1964634.

[23] Z. Selden, "Taming the bear: American liquified natural gas (LNG) exports and the negation of Russian influence in Europe," *Global Affairs*, vol. 6, no. 2, pp. 149–165, 2020, doi: 10.1080/23340460.2020.1780460.

[24] R. Connor, R. J. Heffron, A. A. Khan, and E. Perkins, "Legal strategies for the mitigation of risk for energy infrastructure projects," *Journal of Energy & Natural Resources Law*, vol. 37, no. 1, pp. 47–66, 2018, doi: 10.1080/02646811.2018.1455338.

[25] X. Shi, "The future of ASEAN energy mix: A SWOT analysis," *Renewable and Sustainable Energy Reviews*, vol. 53, pp. 672–680, 2015, doi: 10.1016/j.rser.2015.09.010.

[26] A. Mikulska, "Gazprom and Russian natural gas policy in the first two decades of the 21st century," *Orbis*, vol. 64, no. 3, pp. 403–420, 2020, doi: 10.1016/j.orbis.2020.05.004.

[27] B. K. Sovacool, A. L. D'Agostino, and M. J. Bambawale, "The socio-technical barriers to Solar Home Systems (SHS) in Papua New Guinea: 'Choosing pigs, prostitutes, and poker chips over panels'," *Energy Policy*, vol. 39, no. 3, pp. 1532–1542, 2011, doi: 10.1016/j.enpol.2010.12.027.

[28] A. Chaturvedi and S. Samdarshi, "Energy, economy and development (EED) triangle: Concerns for India," *Energy Policy*, vol. 39, no. 8, pp. 4651–4655, 2011, doi: 10.1016/j.enpol.2011.05.009.

[29] W. Strielkowski, A. Sherstobitova, P. Rovny, and T. Evteeva, "Increasing energy efficiency and modernization of energy systems in Russia: A review," *Energies*, vol. 14, no. 11, p. 3164, 2021, doi: 10.3390/en14113164.

[30] W. Strielkowski, L. Civín, E. Tarkhanova, M. Tvaronavičienė, and Y. Petrenko, "Renewable energy in the sustainable development of electrical power sector: A review," *Energies*, vol. 14, no. 24, p. 8240, 2021, doi: 10.3390/en14248240.

***Rifah Tasnia (Corresponding Author)**
Master of Business Administration, Pennsylvania State University, University Park, USA
E-mail: rifahworks@gmail.com