Scientific Research Publishing

Journal of Power and Energy Engineering, 2022, 10, 14-28
https://www.scirp.org/journal/jpee
ISSN Online: 2327-5901
ISSN Print: 2327-588X

An Analysis of Influencers of Energy Security for SMEs in the Greater Accra Region of Ghana

Jones Lewis Arthur[1,2*], George Locher[3]

[1]Department of General Agriculture, Faculty of Applied Science and Technology, Sunyani Technical University, Sunyani, Ghana
[2]Institute of Distance Learning, Kwame Nkrumah University of Science and Technology, Kumasi, Ghana
[3]Kwame Nkrumah University of Science and Technology, Kumasi, Ghana
Email: *jonesarthur2002@yahoo.co.uk, *jonesarthur2002@stu.edu.gh, georgelocher@ymail.com

How to cite this paper: Arthur, J.L. and Locher, G. (2022) An Analysis of Influencers of Energy Security for SMEs in the Greater Accra Region of Ghana. *Journal of Power and Energy Engineering*, **10**, 14-28.
https://doi.org/10.4236/jpee.2022.102002

Received: December 28, 2021
Accepted: February 19, 2022
Published: February 22, 2022

Abstract

Investments in the exploitation of the continent's raw material reserves have resulted in little (positive) impact on the energy security situation within Africa. This paper attempts to explore factors influencing the level of energy security of Small Medium Enterprises (SMEs) in the Greater Accra Region of Ghana, and from the dimension of availability, affordability, economic efficiency and environmental stewardship or sustainability of energy. The cross-sectional survey design was employed as the design for the collection and analysis of data. The study applied a quantitative research method in examining the indicators of energy security for SMEs in Accra Metropolis in the Greater Accra Region of Ghana. The population covered about 500 SMEs who have about 100 employees and total revenue of $1 million or the equivalence in Ghana Cedis. A sample of 246 was selected through a cluster and simple random sampling. The analysis adopted statistical techniques to conduct descriptive, exploratory and inferential analysis of the data collected. Factors that influence the level of energy security of SMEs are broadly categorized into the environment and economic change, political factors, physical disruptions and market conditions. Generally, the level of energy security under the availability dimension is medium among the SMEs. Issues of affordability, economic efficiency and environmental stewardship provide high medium interventions on energy security for SMEs. It is recommended that managers of Ghana's energy sector should ensure prudent management of the country's energy resources since the disruption of supply lines or sources form the key conditions that influence the energy security level of SMEs. SMEs should adopt energy efficiency measures to ensure that energy is conserved for future use.

Keywords

Energy Security, Influencers, SMEs, Efficiency, Environmental Stewardship,

Political, Market Condition

1. Introduction

Energy Security (ES) is an old but evolving concept of varied definitions [1] [2]. The concept has received attention from different sectors including science, national energy policies, politics, health, international relations, and as a national security issue [3]. Energy security has been defined from many perspectives: as the association between national security and the availability of natural resources for energy consumption [4]; as an assurance of meeting the daily energy needs of consumers through appropriate actions that gives better lives to people in a society [5]; and as maintenance of the transnational relationship that guarantees citizens of countries gain access to external sources of energy [4]. The definitions are, therefore, case-focused among which include the state of security of supply [1] sufficiency of energy to enable the national economy to function and considered acceptable politically [6] and supply, import and uninterrupted energy at an affordable price [7]. The different debates on the definition make it difficult to arrive at a common approach to assess ES.

Recently, the concept of ES has gained significant attention as an environmental and social science phenomenon as ES experts from the environmental science perspective have argued that energy security is underpinned by international security perspectives since environmental or climate catastrophic could cause mass migration of refugees [8]. As a result of the varied contexts of the concept in energy studies, many policy planners continue to downplay the significance of the environment in ES [9]. It is insightful, therefore, to acknowledge that energy poverty as a domestic flow issue is regarded within the realm of the social welfare system and not energy security because energy security concepts usually assume existing energy flows [10]. However, if energy poverty arises from energy imports, then one could relate it to international energy security. In such circumstances, ES could be argued to be capable of assuming an economic perspective. But, information on the influencers does not exist in several organizations. These organizations continue to face challenges of ES partly because of the failure to understand the significant roles that a mix of factors including environmental concerns could play in energy management.

ES from the economic perspective relates to the ability of households, businesses, and governments to accommodate disruptions in supply in energy markets [11]. In this regard, the concept of ES could have long-term and short-term perspectives [12]. These include the long-term, where energy security is concerned with timely investments to supply energy in line with economic developments and environmental needs and the short-term energy security deals with the ability of the energy system to react promptly to sudden changes in the supply-demand balance [12]. For example, some sub-Saharan countries such as Ghana had faced criti-

cal challenges in energy supply which culminated in huge energy debts for many industries and with some industries folding up due to the energy crisis. Many enterprises had had to struggle to stay in business due to critical challenges caused by energy insecurity during 2014-2016 in Ghana. In all, it is important to note that understanding issues of ES will require a better understanding of the complexities of the dimensions and parameters of the concept since the output would ultimately provide better options for many enterprises to be gain security in their requirements.

One common energy security dimension in the scholarly discourse has included issues of availability, affordability, economic efficiency and environmental stewardship or sustainability of energy as well as issues of the timeframe, resilience, health, culture, literacy, policy, employment, military, cyber security and location [2]. These debates, however, suggest that issues of Energy security differ from both the domestic and international perspectives and this variance of ES have become a critical component of many industrial set-ups including Small Medium Enterprises (SMEs) due to the impact that the concept could have on revenue mobilization, cost of doing business and general acceptability of a business entity.

Some studies have shown that the important dimensions of energy security for SMEs include availability, affordability, economic efficiency, and environmental sustainability [13] [14] [15]. But, the availability dimension of energy security is often highlighted as the most dominant factor [1]. [16]'s empirical analysis of 22 countries revealed that the availability dimension of energy security was highly researched (81%), followed by 51% for affordability, 34% efficiency and 26% for environmental stewardship. The availability dimension of energy security speaks more to the capacity to diversify fuel to provide energy services as well as locations of facilities used to minimize dependence on foreign suppliers [17]. Availability is distinctively categorized into the security of supply, self-sufficiency, diversification, renewable energy sources, and technological maturity [17] [18]. It is important to note that affordability plays a key role in establishing the state of energy security for many enterprises.

Energy Security in Africa

According to [19] the puzzling thing about energy security in Africa is that expanded exploitation of the continent's raw material reserves has resulted in little (positive) impact on the energy security situation within Africa. A report by the [20] suggests that despite the boom in energy resources in Africa, Africans have access to and consume far less energy than countries in any other continent. As of 2007, annual consumption of all primary energy sources in Africa was on 15.4 million British thermal units (Btu) per person in Africa while the world's average per capita energy consumption was 70.8 Btu, and US 337.1 Btu of energy per year (almost 22 times the figure for average African) [19]. The difference even widens up when it comes to the consumption of modern energy sources

such as fossil fuels and electricity. [20]'s report indicated that outside South Africa, 80 percent of Sub-Saharan Africans' primary energy demand is for biomass, namely wood fuels, charcoal, agricultural residues, and animal dung. As of 2010, a huge 71 percent of Sub-Saharan African households reportedly lack access to electricity [21]. This is at the backdrop of the fact that there is an adequate generation of energy in many countries in Sub-Saharan Africa [19].

According to [22], Africa on average exports over 90 percent of its extracted petroleum resources annually. Ironically, local fuel shortages have, however, been increasing in the continent annually due to limited refining capabilities as a result of the lack of/or poorly maintained facilities. The outcome of this dilemma is that even oil-endowed states in Africa have to rely on imported fuel, which is often in short supply resulting in low energy security in these countries [19]. It is significant to conclude that resources drain and low energy security are considered significant impediments to the development of Africa.

According to [23], access to modern energy resources is a vital contributor to improvements in human well-being and economic growth. Electrification enhances lighting and communications and allows for the mechanization of production and growth of small businesses [24]. Refrigeration with electricity reduces post-harvest losses, improves food security and the storage of medical supplies which all contribute to economic growth and human well-being. Access to petroleum-based fuels strengthens internal transportation networks to facilitate trade and human mobility, which contribute to economic expansion in ways that enhance the quality of life [19]. The inability to explore ES for many SMEs has made it difficult for many organizations to gain a competitive advantage for accelerated growth and development in their corporate agenda.

Ghana has now enjoyed stable power supply since independence. In 2014-2016 Ghana faced one of the worse powers that exposed the volatility of many ill-prepared companies [25]. Many SMEs in major cities such as Accra, Kumasi and Takoradi were seriously affected by the power crisis and the resultant load shedding that led to power rationing in the major cities where consumption is the highest [25]. Many companies especially small scale companies in Accra were unable to survive the power crisis [26]. The alternative option to deal with the energy crisis was for many SMEs to invest in the purchase expensive standby generators/plants to serve as backup for their operations [27] [28]. SMEs that could not afford the rather expensive alternative had to reduce their working hours leading to decreased production, loss of profit margins and in extreme cases led to the collapse of some businesses [25]. It was, however, difficult to establish their current level of energy security and how that affects their productivity. It is also yet to be known what factors influenced ES of SMEs in the country and what plans are in place to mitigate the effect of energy security on these firms.

Without knowledge of the level of energy security, it would be difficult for most SMEs to improve their level of energy security policy and formulate interventions to properly address the impact of energy on SMEs. The current state of

low energy security is, therefore, a threat to economic and social wellbeing. The study attempts to explore factors influencing the level of energy security of SMEs in the Greater Accra Region of Ghana.

The study would consider the following specific objectives;

1) To ascertain factors that influence the level of energy security of SMEs in the Greater Accra Region of Ghana;

2) To examine the impact of the influencers of energy security among SMEs in the Accra Metropolis of Ghana.

2. Methods

The cross-sectional survey design was employed for the collection and analysis of data on influencers of energy security for SMEs in Accra Metropolis in the Greater Accra Region of Ghana. Cross-sectional research designs according to [29], involves surveys relying on data collected at one point in time to make inferences about a population of interest [30]. The study covers a sample of SMEs from different sectors of the economy. This was to allow for a comprehensive study that addresses the challenge of representativeness often associated with cross-sectional surveys. Since the issue of energy security is a current challenge that requires timely action research to address the cross-sectional survey, it is most appropriate to obtain and apply quick and timely empirical findings [31].

The study employed the quantitative research method to examine the strengths of the influencers on energy security (ES) [32] [33]. In this study, descriptive research is applied to suit the chosen cross-sectional survey design. [33] has indicated that in quantitative descriptive studies relationship is established through measures of association whereas casual relationship applies to only experimental studies. In this case, therefore, the impact of influencers on energy security for SMEs is measured by a measure of association rather than cause and effect.

The study used a structured questionnaire in the data collection process [4]. A requirement for quantitative methods indicated by [34], is that the sample size should be large and representative of the population of interest.

The population for this study included all SMEs operating in the Accra Metropolis in the Greater Accra Region of Ghana. Operationally the Venture Capital Trust Fund Act 2004 (Act 680) defines SMEs as firms, enterprises or companies engaged in specific economic activity and have at most 100 employees or total revenue in Ghana Cedis equivalent of US$ 1 million [35]. In this regard, all firms and companies in the Accra Metropolis that satisfied the VCTF condition were included in the study population. The study unit for the population included only the owners or managers of SMEs operating in the Accra Metropolis of the Greater Accra Region. The population size is fluid as a specific number of SMEs in the Accra Metropolis is unavailable. A pessimistic appropriation of the number of SMEs in the Accra Metropolis is nevertheless given as a figure a little over 500 [36].

To ensure that the sample is adequate, and is representative of the study popula-

tion, the [37] approach to sample size determination was employed. In this study, the number of SMEs in the Accra Metropolis is unknown, but it is estimated that about 80% of all firms in the Accra Metropolis are SMEs. So the Cochran's formula for sample size determination was used to access the sample. The formula is given as:

$$n_0 = \frac{Z^2 pq}{e^2}$$

where: e is the desired level of precision (*i.e.* the margin of error), p is the (estimated) proportion of the population that has the attribute in question, q is $1 - p$. The z-value is found in a Z table. Based on the population proportion of SMEs estimated as 80% (0.8) and precision of 5% (0.05), the sample size for this study was calculated as follows:

$$n_0 = \left((1.96)^2 (0.8)\ (0.2)\right) \Big/ (0.05)^2 = 246 .$$

Therefore, the appropriate sample size for the study was 246 SMEs. In selecting the 246 SMEs, a cluster sampling method was employed. The cluster sampling approach involved dividing the total population into groups and a simple random sampling was employed to select the samples from each group. Cluster sampling is a sampling plan used when mutually homogeneous yet internally heterogeneous groupings are evident in a statistical population. In applying this sampling method, the Accra Metropolis was divided based on the sub-metropolis and from each sub-metropolis, a simple random sampling was employed in selecting the SMEs. The simple random sampling process in this study involved the use of the random number generation function in Microsoft excel. The random number generation function was used to generate and assign random numbers to the number of SMEs to be sampled and matched with unique numbers assigned to each SME for selection.

In this sampling plan, the total population was divided into clusters of submetros and a simple random sample of the groups is selected. The sub-metropolis within the Accra Metropolitan Districts from which the SMEs were selected included the Ablekuma South Sub-Metropolitan District, Ashiedu Keteke Sub-Metropolitan District and Okaikoi South Sub-Metropolitan District.

The study relied on primary data collected from each SME through the administration of questionnaires to the owner/manager of each selected SME. The use of primary data was informed by the fact that as a cross-sectional study, the data needed to be current enough to reflect the existing status of indicators/influencers of energy security and the effect on SMEs. Thus the data collected included background information of the SMEs, responses on the level of energy security among the SMEs and factors that influence the level of energy security.

Data for the study were obtained through an administration of structured questionnaires administered to the managers/owners of the selected SMEs in the Accra Metropolis. The questions were formulated by the researcher based on the objectives of the study, literature review and some existing instruments that meas-

ured various concepts covered by the study. The questionnaire was organized in two (2) thematic areas; sections A and B. Section A covered the background information of the SMEs while section B explored indicators/influencers of energy security of the firms. The questions under Section B were developed from the dimension of energy security as presented in the literature of [15]. A 5-point Likert scale of 1 to 5 to represent strongly disagree to strongly agree were applied to the majority of the questions.

The designed questionnaire was administered to the respondents in person. The questionnaire distribution was preceded by pre-testing of the instrument in a similar population in the Kumasi Metropolis. The pre-testing was necessary to ensure clarity of questions and identify and avert any challenges that may surface in the actual administration of questions to the respondents.

To ensure the integrity of the findings of the study, steps were taken by the researcher to ensure validity and reliability in the instruments and the data collected. Both validity and reliability are necessary for the quality of research [38]. A combination of measures including experts review, pretesting and statistical tests was employed to measure and ensure all three kinds of validity were achieved.

In this study, the Cronbach alpha test was employed to test the level of reliability based on the Cronbach alpha coefficient which ranged from 0 to 1.00. Generally, a Cronbach alpha value of 0.70 or higher is necessary to ensure high internal consistency and reliability. Where the Cronbach alpha value is less than 0.70 for any construct, several items were deleted until the desired Cronbach alpha value was achieved.

The data collected were analyzed using the IBM Statistical Product and Service Solutions (SPSS) statistics version 23. Before the data analysis, the responses obtained were edited and cleaned to ensure completeness, consistency and legibility. After the data cleaning, the responses were coded and entered into the SPSS for analysis. The analysis employed the statistical technique to conduct descriptive, exploratory and inferential analysis of the data collected. The descriptive statistical analysis included the use of frequency count, means and standard deviation to establish the level of impact of influencers on energy security among the SMEs. Exploratory factor analysis (EFA) was also performed to identify factors influencing SMEs level of energy security and the relative important index (RII) analysis was conducted to rank these influences.

3. Results and Discussions

3.1. Profile of SMEs

The results show that in terms of ownership, nearly half (46.3%) of the SMEs are of sole proprietorship whereas about a quarter are private limited companies. Partnership companies were the least group constituting 12.8 percent while 14.6 percent are family-owned. Clearly, the results show the dominant ownership structure of the SMEs to be a sole proprietorship and private limited companies.

This observation resonates with the [36] Integrated Business Establishment Survey (IBES) report which indicated that most SMEs in Ghana are of sole proprietor ownership, private limited companies, or family businesses.

The findings of the study further revealed that trade and commerce was the dominant sector covering 31.7 percent of all firms covered in the study whilst 26.8% were into the agriculture and manufacturing sectors. Other services followed included General Service, Health and wellness, and Cosmetic/photography and Catering/restaurant that constituted less than 10 percent each. The fact that the dominant sectors of the SMEs included trade and commerce, as well as agriculture and manufacturing, reflect the fact that Ghana is a developing country with a characteristic primary production sector [39]. Out of the 205 SMEs studied (questionnaires retrieved from the respondents), 70.8 percent have operated for at most 5 years, 17.1 percent for 15 or more years, 7.3 percent for 6 to 10 years, and 9.8 percent for those that have operated for 11 to 15 years. The result, therefore, captured a blend of old and new SMEs. With the number of employees, the study also showed that only 12.2 percent of the SMEs have 20 employees, the majority (58.5%) has 5 or fewer employees and 19.5 percent 6 to 10 employees. The number of employees from the SMEs also reflected characteristics of SMEs, that is, with relatively fewer numbers of employees (**Table 1**).

The monthly turnover of the SMEs indicated the majority (56.1%) with a monthly turnover of less than GH¢20,000 and 14.6 percent having more than GH¢50,000.00. Again, nearly a quarter of the SMEs recorded a monthly turnover of between GH¢20,000 and GH¢30,000. The monthly turnover of the SMEs reflect the nature of the SMEs as confirmed by the Venture Capital Trust Fund Act 2004 (Act 680) that stated that; SMEs do not exceed 100 employees or have total revenue of US$1 million or the Cedis equivalent. Thus the findings show that the companies contacted were within the scope of SMEs.

3.2. Exploratory Factor Analysis

The multi-items construct for the factors that influence the level of energy security of the SMEs consisted of 16 items. The use of exploratory factor analysis was informed by the need to reduce the 16 items to fewer factors that explained the variation in the statements. The exploratory factor analysis was performed by the principal component analysis extraction method and varimax rotation. Preliminary analyses such as the Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity were performed to establish the suitability and appropriateness of data for factor analysis. The results from the analysis presented in **Table 2** show KMO of 0.642 and significant Bartlett's test of sphericity (χ^2 (120) = 3013.98, $p < 0.0001$) which indicates sampling adequacy and sufficient correlation among the items (variables) to warrant factor analysis. [40] has established a threshold KMO value of 0.5 as adequate for the use of factor analysis. A significant Bartlett's test of sphericity also indicates that the null hypothesis of Bartlett's test which states that the original correlation matrix is an

Table 1. Nature and description of SMEs.

	Response	Frequency	Percent
SMEs ownership	Family owned business	30	14.6
	Partnership	25	12.2
	Private limited company	55	26.8
	Sole proprietorship	95	46.3
Sector of business	Agriculture/manufacturing	55	26.8
	Cosmetic/photography	15	7.3
	Catering/restaurant	20	9.8
	Engineering/project consulting	25	12.2
	Trade and commerce	65	31.7
	General service	20	9.8
	Health and wellness	5	2.4
Years of existence	5 years or less	135	70.8
	Between 1 and 5 years	85	41.5
	Between 6 and 10 years	15	7.3
	Between 11 and 15years	20	9.8
	15 years and above	35	17.1
Employees	11 to 15	20	9.8
	5 or less	120	58.5
	6 to 10	40	19.5
	More than 20	25	12.2
Monthly turnover	GH¢20,000.00 to GH¢30,000.00	50	24.4
	GH¢30,000.00 to GH¢40,000.00	10	4.9
	Less than GH¢20,000.00	115	56.1
	More than GH¢50,000.00	30	14.6

Source: field survey, 2020.

identity matrix for which there is no sufficient correlation for factor analysis is rejected.

Based on the satisfactory preliminary analysis, the factor extraction analysis was performed using the principal component analysis (PCA) approach to determine the fewest number of factors that can be used to represent the interrelations among the variables. The PCA approach uses an orthogonal transformation to convert all possibly correlated variables into a set of values of linearly uncorrelated variables (principal components). The results from the PCA analy-

sis as presented in Table 2 show that four (4) components have an Eigenvalue of at least unity as recommended by [40] for extraction. The four (4) principal factors cumulatively explained 75.2% (Rho = 75.20) of the variability among the items. This means that the four (4) factors are the fewest number of latent variables that explained all 16 statements.

The extracted principal components and the factor loadings after varimax rotation are also presented in Table 2. Based on the statements that load strongly on each principal component, the factors were identified and labelled accordingly. The first component was loaded on strongly by 7 factors with Cronbach alpha of 0.91 indicating high internal consistency. The first component (Component 1) is labelled "environment and economic change" because the items that

Table 2. Analysis of principal factors influencing SMEs energy security.

Factors	Items	Components				Communalities
		1	2	3	4	
Environment and economic change	EEC1	0.624				0.588
	EEC2	0.599				0.643
	EEC3	0.833				0.735
	EEC4	0.819				0.689
	EEC5	0.74				0.624
	EEC6	0.733				0.812
	EEC7	0.735				0.829
Political factors	PF1		0.85			0.777
	PF2		0.801			0.78
	PF3		0.82			0.834
	PF4		0.72			0.78
Physical disruption	PD1			0.803		0.847
	PD2			0.938		0.907
	PD3			0.538		0.712
Market conditions	ID1				0.568	0.737
	ID2				0.77	0.737
	Cronbach alpha (a)	0.91	0.855	0.697	0.472	
Rho = 75.20	No. of items	7	4	3	2	
No of obs = 205	Eigen Values	6.91	2.27	1.81	1.05	
KMO = 0.642	% variance	27.8	21.3	13.5	12.7	
χ^2 (120) = 3013.98***	% cumulative	27.8	49.0	62.5	75.2	

Source: field survey (2020).

load on it are all related to change in environmental and economic conditions. Component 2 was also loaded strongly by four items with Cronbach alpha of 0.855 and labelled Political factors. Component 3, on the other hand, consist of 3 items with Cronbach alpha of 0.697 and labelled physical factors while Component 4 labelled as market conditions consist of 2 items and Cronbach alpha 0.472.

3.3. Descriptive Analysis of Principal Factors Influencing Energy Security

As shown in Table 3, the factors influencing the energy security of SMEs can be categorised as global environmental and economic factors, political factors, physical disruptions and market conditions. With regards to the identified environmental and economic factors that influence energy security, it was noted that the respondents most agreed that "market price volatility" (Mean = 3.7, SD = 0.846) and increase in population and urbanization (Mean = 3.6, SD = 1.038) influence energy security levels of SMEs. The results further showed that respondents on average were neutral with regards to an increase in economic growth (Mean = 3.4, SD = 0.769), sudden change in the economic purchasing power of consumers (Mean = 3.4, SD = 0.906), geopolitical influence (Mean = 3.4, SD = 1.145); environmental and natural disasters (Mean = 3.3, SD = 0.955) and global restriction on energy use due to environmental concerns (Mean = 3.1, SD = 0.869). The results mean that the strongest environmental and economic factors that influence energy security include market price volatility and an increase in population and urbanization. The above findings concur with findings of studies of [41] that identified price changes and the growing trend of population and urbanisation as conditions undermining energy security.

The statements that describe political factors that influence the energy security of SMEs include disputes over the sovereignty of resources, political instability in oil-producing regions, protests about environmental change and unhealthy relationships with energy supplying countries. The results showing the extent to which the respondents have agreed with these statements as factors that influence the energy security of SMEs are also presented in Table 3. From the results it was noted that the respondents on average were neutral with regards to their level of agreement with disputes over the sovereignty of resources (Mean = 3.4, SD = 1.126), unhealthy relationship with energy supplying country (Mean = 3.3, SD = 0.902), protests about environmental change (Mean = 3.2, SD = 0.927) and political instability in producing regions (Mean = 3.2, SD = 0.934) as factors that influence their level of energy security. The results mean that political conditions do not appear to be strong influencers of the energy security level of SMEs.

Under physical disruption-factors that influence energy security level of SMEs, the results showed that respondents on the average were neutral about over-reliance on any one supplier or group of suppliers (Mean = 3.7, SD = 0.886); mismanagement of the energy sector (Mean = 3.7, SD = 1.039) and disruption of supply lines or sources (Mean = 3.6, SD = 1.126). This result meant that among the factors

Table 3. Principal factors influencing energy security.

Principal Factor	Statement	Mean	SD	N
Environment and economic change	Market price volatility	3.7	0.846	205
	Increase in population and urbanization	3.6	1.038	205
	Increase in economic growth	3.4	0.769	205
	Sudden change in the economic purchasing power of consumers	3.4	0.906	205
	Geopolitical influence	3.4	1.145	205
	Environmental and natural disasters	3.3	0.955	205
	Global restriction on energy use due to environmental concerns	3.1	0.869	205
Political factors	Disputes over sovereignty of resources	3.4	1.126	205
	Unhealthy relationship with energy supplying country	3.3	0.902	205
	Protests about environmental change	3.2	0.927	205
	political instability in producing regions,	3.2	0.934	205
Physical disruption	Over-reliance on any one supplier or group of suppliers	3.7	0.886	205
	Mismanagement of the energy sector	3.7	1.039	205
	Disruption of supply lines or sources	3.6	1.126	205
Market conditions	Lack of diversity in energy sources	3.93	0.84	205
	Demand from new industries	3.34	0.754	205

Source: field survey (2020), SD = standard deviation.

considered to have influenced energy security are over-reliance on one supplier or group of suppliers of the energy sector, mismanagement of the energy sector and disruption of supply lines or sources. With regards to Market condition factors, the results showed that respondents agreed that lack of diversity in energy sources (Mean = 3.9, SD = 0.84) and demand from new industries (Mean = 3.3, SD = 0.754) were on the average neutral influencers of energy security for SMEs.

4. Conclusions

This study mainly motivated by the adverse impacts of the recent energy crisis in Ghana sought to find out the strengths of influencers of energy security on SMEs in Ghana. Generally, the level of energy security for SMEs as measured in terms of availability is moderate but high for affordability, economic efficiency and environmental stewardship.

Factors that influence the level of energy security of SMEs are broadly categorized into the environment and economic change, political factors, physical disruptions and market conditions. Generally, the level of energy security under the availability dimension is medium among the SMEs. Issues of affordability, economic efficiency and environmental stewardship provide high medium interventions on energy security for SMEs. The environmental and economic changes factors that cover market price volatility and increases in population and urbaniza-

tion represent the conditions that influence the energy security levels of SMEs. The key influencers of the level of energy security of SMEs under physical disruption, were over-reliance on any one supplier or group of suppliers, mismanagement of the energy sector and disruption of supply lines or sources. On issues relating to market conditions, it is important to note that limited energy options for SMEs could undermine the efforts of SMEs to achieve ES.

It is recommended that managers of Ghana's energy sector should provide prudent management of the country's energy resources since the disruption of supply lines or sources forms could influence the energy security level of SMEs. SMEs should adopt energy efficiency measures to ensure that energy is conserved for future use.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

References

[1] Kruyt, B., van Vuuren, D.P., de Vries, H.J. and Groenenberg, H. (2009) Indicators for Energy Security. *Energy Policy*, **37**, 2166-2181. https://doi.org/10.1016/j.enpol.2009.02.006

[2] Azzuni, A. and Breyer, C. (2018) Definitions and Dimensions of Energy Security: A Literature Review. *WIREs Energy and Environment*, **7**, e268. https://doi.org/10.1002/wene.268

[3] Cherp, A. and Jewell, J. (2014) The Concept of Energy Security: Beyond the Four As. *Energy Policy*, **75**, 415-421. https://doi.org/10.1016/j.enpol.2014.09.005

[4] Williams, D. (2009) Energy Security and National Security; Securing US Energy Resources. U.S. Army War College, Carlisle Barracks, PA 17013-5050.

[5] Sorrell, S. (2015) Reducing Energy Demand: A Review of Issues, Challenges and Approaches. *Renewable and Sustainable Energy Reviews*, **47**, 74-82. https://doi.org/10.1016/j.rser.2015.03.002

[6] Willrich, M. (1976) International Energy Issues and Options. *Annual Review of Energy*, **1**, 743-772. https://doi.org/10.1146/annurev.eg.01.110176.003523

[7] IEA (2020) Our Work on Energy Security. https://www.iea.org/topics/energy-security

[8] Luft, S. (2015) Eine Generationsaufgabe. Über die Integration von Flüchtlingen. WESER-KURIER.

[9] Bridge, G., Özkaynak, B. and Turhan, E. (2018) Energy Infrastructure and the Fate of the Nation: Introduction to Special Issue. *Energy Research & Social Science*, **41**, 1-11. https://doi.org/10.1016/j.erss.2018.04.029

[10] Kenderdine, T. (2017) China's Industrial Policy, Strategic Emerging Industries and Space Law. *Asia & the Pacific Policy Studies*, **4**, 325-342. https://doi.org/10.1002/app5.177

[11] Metcalf, G.E. (2014) The Economics of Energy Security. *Annual Review of Resource Economics*, **6**, 155-174.

[12] Hefele, P., Palocz-Andresen, M., Rech, M. and Kohler, J.H. (2018) Climate and Energy Protection in the EU and China: 5th Workshop on EU-Asia Relations in Glob-

al Politics. Springer, Cham. https://doi.org/10.1007/978-3-319-99837-4

[13] Sovacool, B.K. and Brown, M.A. (2010) Competing Dimensions of Energy Security: An International Perspective. *Annual Review of Environment and Resources*, **35**, 77-108. https://doi.org/10.1146/annurev-environ-042509-143035

[14] Ang, B.W., Choong, W.L. and 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

[15] Fang, D.B., Shi, S.S. and Yu, Q. (2018) Evaluation of Sustainable Energy Security and an Empirical Analysis of China. *Sustainability*, **10**, Article No. 1685. https://doi.org/10.3390/su10051685

[16] Brown, M.A., Sovacool, B.K., Wang, Y. and D'Agostino, A.L. (2011) Energy Security Dimensions and Trends in Industrialized Countries. Georgia Tech Ivan Allen College, School of Public Policy, Working Paper Series No. 63, 26 p.

[17] Pavlović, B.S. and Ivezić, D.D. (2017) Availability as a Dimension of Energy Security in the Republic of Serbia. *Thermal Science*, **21**, 323-333. https://doi.org/10.2298/TSCI160923303P

[18] Ren, J. and Sovacool, B.K. (2014) Quantifying, Measuring, and Strategizing Energy Security: Determining the Most Meaningful Dimensions and Metrics. *Energy*, **76**, 838-849.

[19] Meierding, E. (2011) Energy Security and Sub-Saharan Africa. In: Carbonnier, G., Eds., *International Development Policy*: *Energy and Development*, Palgrave Macmillan, London, 44-59. https://doi.org/10.1007/978-0-230-31401-6_3

[20] International Council for Science (2002) Science and Technology for Sustainable Development: Report from the Synthesis Meeting Sponsored by the Initiative on Science and Technology for Sustainability, Third World Academy of Sciences, and International Council for Science. International Council for Science, Paris.

[21] Annual Energy Outlook (2010) Energy Information Administration. Department of Energy.

[22] Florini, A. (2011) The International Energy Agency in Global Energy Governance. *Global Policy*, **2**, 40-50. https://doi.org/10.1111/j.1758-5899.2011.00120.x

[23] Asif, M. and Muneer, T. (2007) Energy Supply, Its Demand and Security Issues for Developed and Emerging Economies. *Renewable and Sustainable Energy Reviews*, **11**, 1388-1413. https://doi.org/10.1016/j.rser.2005.12.004

[24] Cabraal, R.A., Barnes, D.F. and Agarwal, S.G. (2005) Productive Uses of Energy for Rural Development. *Annual Review of Environment and Resources*, **30**, 117-144. https://doi.org/10.1146/annurev.energy.30.050504.144228

[25] Gbeve, P.K. (2016) The Effect of Erratic Power Supply on SME's in the Kumasi Business District of Ghana. Master's Thesis, Kwame Nkrumah University of Science and Technology, Kumasi.

[26] Cobbinah, P.B. and Adams, E.A. (2018) Urbanization and Electric Power Crisis in Ghana: Trends, Policies, and Socio-Economic Implications. In: *Urbanization and Its Impact on Socio-Economic Growth in Developing Regions*, IGI Global, Hershey, PA, 262-284.

[27] Abeberese, A.B., Ackah, C. and Asuming, P. (2017) Productivity Losses and Firm Responses to Electricity Shortages: Evidence from Ghana. *The World Bank Economic Review*, **35**, 1-18. https://doi.org/10.1093/wber/lhz027

[28] Hayford, S. (2012) The Development of Small Medium Enterprises and Their Impact to the Ghanaian Economy. Master's Thesis, Kwame Nkrumah University of Science and Technology, Kumasi.

[29] Lavrakas, P.J. (2008) Encyclopedia of Survey Research Methods. Sage Publications, Thousand Oaks. https://doi.org/10.4135/9781412963947

[30] Alexander, R., Devapriam, J., Michael, D., McCarthy, J., Chester, V., Rai, R., *et al.* (2015) "Why Can't They Be in the Community?" A Policy and Practice Analysis of Transforming Care for Offenders with Intellectual Disability. *Advances in Mental Health and Intellectual Disabilities*, **6**, 33-43.

[31] Vandenbroucke, J.P., von Elm, E., Altman, D.G., Gøtzsche, P.C., Mulrow, C.D., Pocock, S.J., *et al.* (2014) Strengthening the Reporting of Observational Studies in Epidemiology (STROBE): Explanation and Elaboration. *International Journal of Surgery*, **12**, 1500-1524. https://doi.org/10.1016/j.ijsu.2014.07.014

[32] Babbie, E.R. (2010) The Practice of Social Research. Wadsworth Cengage, Belmont.

[33] Banerjee, A. and Chaudhury, S. (2010) Statistics without Tears: Populations and Samples. *Industrial Psychiatry Journal*, **19**, 60-65. https://doi.org/10.4103/0972-6748.77642

[34] Venture Capital Trust Fund (VCTF) (2009) Annual Report on Operations for 2009. Venture Capital Trust Fund, Ghana.

[35] Ghana Statistical Board (2018) Integrated Business Establishment Report. Ghana Statistical Service, Accra.

[36] Cochran, W.G. (1977) Sampling Techniques. 3rd Edition, John Wiley & Sons, New York.

[37] Heale, R. and Twycross, A. (2015) Validity and Reliability in Quantitative Studies. *Evidence-Based Nursing*, **18**, 66-67. https://doi.org/10.1136/eb-2015-102129

[38] Tambunan, T. (2008) SME Development, Economic Growth, and Government Intervention in a Developing Country: The Indonesian Story. *Journal of International Entrepreneurship*, **6**, 147-167. https://doi.org/10.1007/s10843-008-0025-7

[39] Kaiser, H.F. (1974) An Index of Factorial Simplicity. *Psychometrika*, **39**, 31-36. https://doi.org/10.1007/BF02291575

[40] Avtar, R., Tripathi, S., Aggarwal, A.K. and Kumar, P. (2019) Population-Urbanization-Energy Nexus: A Review. *Resources*, **8**, Article No. 136. https://doi.org/10.3390/resources8030136

[41] Wang, Q., Su, M., Li, R.R. and Ponce, P. (2019) The Effects of Energy Prices, Urbanization and Economic Growth on Energy Consumption Per Capita in 186 Countries. *Journal of Cleaner Production*, **225**, 1017-1032. https://doi.org/10.1016/j.jclepro.2019.04.008