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Article

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Information Communication Technology Access and Use towards Energy Consumption in Selected Sub Saharan Africa

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ABSTRACT

Major new opportunities abound from energy integration among regions in Africa with the sole aim of reducing transaction costs and with the role of Information Communication Technology (ICT), it would take energy from where it is easily affordable to places where it is needed. Given the hullabaloo over the net energy-saving impact of ICT, this study takes on a new perspective, that is, employing household energy consumption, to ascertain the use of ICT by household in accessing energy. The study reconnoiters the degree to which Energy integration among the five regional power pools in Africa can achieve ending energy poverty among regional adherents by means of three measures of energy sustainability, explicitly: energy security, energy equity and environmental sustainability**.** The study utilizes the Pooled Ordinary Least Squares technique on data from the SSA economies over the period 2000-2019. The study expects the results to help in suggesting the need for the acceleration of ICT development in Africa (Sub-Saharan) nations, given the universal communal mission of sustainable energy consumption.

Keywords: Technology and Distribution, Common Knowledge, Aggregate Energy Consumption, Sustainable Development, Green Technology, ICT-based
JEL Classifications: O330, D8, Q430, QO10, Q4, Q550, O300, D13

1. INTRODUCTION

Towards a way of supportable advancement for Africa, bearings prompting clean energy have become clearer for strategy making. As a model of advancement, it accentuates an improvement procedure that coordinates energy worries in objective seven into financial and social goals to guarantee that group of people yet to come have adequate assets for their turn of events. It gives chance to economies to develop and create while likewise utilizing assets in a feasible way that doesn't dirty the environment and make wellbeing concerns. There is no uncertainty that economic improvement is the most favored methodology for accomplishing advancement destinations as embodied in the practical improvement objectives (SDGs) of the United Nations (Akinyemi et al., 2019).

The power hole alludes to both the gracefully request ambiguity in network associated areas and the inadequacy of access in off-lattice locales. Shutting the power hole in Sub-Saharan Africa (SSA) is a multidimensional assignment with focal ramifications for how to outline the district's energy issue in general (Hilty et al., 2010; Avila et al., 2017). The Africa Union perceives this potential and expectations that Africa Continental Free Trade Agreement will go far toward accomplishing its objective of 20% ozone harming substance decrease by 2030 by showing ICT for energy effectiveness through energy mix among the different Power Pools (Houghton, 2014). All partners need to guarantee that the impact of ICT on the energy segment is utilized lengthways with the other energy arrangements. Joined Nations has ordered 12 ICT-put together advancements with potential contact with respect to the energy segment to acknowledge manageable turn of events. African Countries ought to think about every one of these advancements in the energy arrangement (Fagas et al., 2016). The youngsters in African nations are a lot of sharp about the ICT, and government should capitalize on it by giving stable force and power in ICT applications, for example, matrix the board, load examination, sensors for remote estimating, chips and controllers for observing, brilliant meters and mechanized dispatch programming (Amin and Rahman, 2019).

On this note, the current investigation takes a gander at the field multiplied by these two primary issues: ICT's own energy utilization and ICT's capability to instigate energy effectiveness over the economy. In the examination's way to deal with these issues, the investigation grasps energy mixes to decrease the energy awkwardness among African countries. The examination's goals are to feature the pattern of energy utilization, and inspect the effect of energy joining towards energy gracefully. To accomplish this goal, the investigation uses the Pooled Ordinary Least Squares method of estimation. The rest of the paper is designed as follows. Segment 2 arrangements with issues identifying with writing survey encompassing access and utilization of data correspondence innovation in energy utilization; segment 3 gives the exploration technique as appear to be appropriate for the investigation and data about the SSA nations. Area 4 gives exact outcomes and the last segment closes the paper.

2. BRIEF REVIEW OF LITERATURE

The present improvement of ICT being in transit of energy sparing is still under discussion. While numerous investigations uncovered that the ICT had an energy sparing impact (Schulte et al., 2016; Zhang and Liu, 2015; Kramers et al., 2014) with considers contended that it could animate energy use through different instruments Cho et al., 2007; Saidi et al., 2017; Saorsky, 2012), and a few examinations noticed the distinctions of ICT's effects among parts (The European Commission, 2008) or gatherings of economies (Ishida, 2015). As indicated by Takase and Murota, 2004, the general effect can be separated into a pay impact and a replacement impact. Concerning the salary impact, the ICT as a sort of universally useful innovation, is extensively identified with creation action and private life which include energy use, so its advancement can prompt energy request by invigorating financial development (Zhou and Zhou, 2018). With respect to replacement impact, the ICT area may diminish energy use by supplanting the customary areas, given that the ICT part and its items are generally less energy concentrated (Takase and Murota, 2004; Zhou and Zhou, 2018; Romm, 2002). Additionally, Hilty and Hercheui (2017) contended that, while the above impacts occurred in short and medium term, the most mixing effect of ICT on human conduct and society may happen over the long haul.

In Akinyemi et al. (2019), coordinating physical framework is an important however insufficient condition for accomplishing further territorial reconciliation and expanded exchange among African nations (UNECA, 2010). Featuring the job of territorial coordination in power maintainability in Southern Africa, Montmasson-Clair and Deonarain (2017) opined that three key components are significant in utilizing provincial mix to add to improved power manageability in the SAPP area. These variables incorporate fit arrangements and administrative systems, sufficient basic organizations and specialized framework, and composed execution. Likewise, there is additionally the presence of intensity pools. Force pools have been seen as the best and best system for handling Africa's energy issues (Niyimbona, 2005) and furthermore amplifying Africa's unevenly conveyed energy assets. There are five territorial force pools in Africa, to be specific SAPP, WAPP, Central Africa Power Pool (CAPP/PEAC), East Africa Power Pool (EAPP) and Comite Maghrebin de l'Electricite (COMELEC) which is the North Africa locale. A force pool is characterized as a gathering of associations that work their capacity frameworks together for shared advantages (UNECA, 2010). As indicated by Avila et al. (2017), provincial co operation, which is upgraded by power pools and cross border transmission systems, will be basic to shutting the power hole in SSA. Its advantages go from economies of scale to a solid and secure gracefully of energy, streamlining of assets, energy cost differential, justifying venture and expanding the volume of power exchange, among others. It can likewise lessen reliance on petroleum product imports by empowering huge concentrated sustainable assets to be shared (Avila, 2017).

ICT improvement can animate monetary development with not exactly proportionate increment of energy use (that is. energy efficiency improvement.) if the ICT doesn't identify with energy profitability improvement, we ought to reexamine its job in accomplishing our practical advancement objectives and should start relating approaches. Be that as it may, as far as we could possibly know, existing investigations only here and there concentrated on such a point of view. Albeit a few scientists noticed that ICT could improve energy efficiency (Salahuddin and Alam, 2015; Shahiduzzaman and Alam, 2014), shockingly such a perspective right now needs support from observational examinations. To summarize, regardless of whether ICT can advance energy reserve funds at the macroeconomic level is as yet a significant under-banter issue. To comprehend the connection among ICT and energy utilization, past examinations gave distinctive effect instruments. Among these instruments, energy profitability improvement is a key measure to accomplish supportable energy utilization in the hypothesis. Subsequently, exact examinations on the connection among ICT and energy profitability can give new confirmations with respect to the above discussion.

3. METHODOLOGY AND DATA

3.1. Model Specification

Literature of both theoretical and empirical literature such as Shahbaz et al. (2014) and Zheming et al. (2018) the general model detail of the energy/power consumption work appears in condition/equation 1.

$$ENC = f(MOT, INSTI, ENI, GDPGR, TRD) \qquad (1)$$

Where EC, ICT, INSTI, ENI, GDPGR, TRD stands for energy consumption, mobile technology, institutions, energy intensity, GDP growth rate and trade openness.

Equation 1 is changed into equation 2 when introduced as an econometric estimation model.

$$ENC = \beta_0 + \beta_1 ICT_{it} + \beta_2\, INSTI_{it} + \beta_3\, ENI_{it} + \beta_4\, GDPGR_{it} + \beta_5 TRD_{it} + \varepsilon_{it} \quad (2)$$

Note: β_0 is the intercept, β_1 represents the coefficient of mobile technology, β_2 is the coefficient of institutions, β_3 is the coefficient of energy intensity, β_4 is the coefficient of GDP growth rate, β_5 is the coefficient of trade, and ε is the error term. In this analysis, only significant coefficients are interpreted giving the ceteris paribus argument, therefore mobile technology (ICT), energy intensity, GDP growth rate and trade are the variables with significant parameter estimates which all have a positive relationship except GDP growth rate.

Regarding the justification of the variables in the model and the respective apriori expectations, Sadorsky (2012) says that a positive relationship exists among ICT and energy/power consumption. Be that as it may, as indicated by Horner et al. (2016) and Han et al. (2016), ICT was found to have negatively affected energy utilization. Inglesi-Lotz and Morales (2017) expressed that more elevated levels of training had a critical positive effect on energy utilization in creating nations. Yan et al. (2018) ICT had a huge constructive outcome on energy profitability. Study uncovers that the higher the degrees of monetary development, the more the expansion in the quantity of financial exercises which utilizes and require heaps of power (Aye and Edoja, 2017).In line with Tsaurai (2019a), exchange transparency increases the quantity of energy utilize connected assembling exercises in the economy, anyway it could likewise negatively affect energy use (Grossman and Kruger 1991).

3.2. Technique of Estimation

3.2.1. Pooled ordinary least squares (POLS)

Panel data analysis denotes to the statistical analysis of data set comprising and consisting of multiple observations on each sampling unit. It is a combination of a variety of time series and cross-sectional units. Pooled OLS, Fixed effects and random effects are the three major methods for panel data regression. The pooled OLS is a pooled linear regression that is arguably sufficient and may not require fixed or random effects. This estimation technique for panel data adopts a constant intercept term irrespective of the duration and cross-section of the group. Furthermore, this model does not recognize distinct homogeneities in data. A pooled OLS model is usually a stationary and balanced panel. Here, dummy variables are included despite its homogenous nature. This study is using a sample with over 50 observations. This model has a common intercept and is expressed as follows:

$$Y_{it} = \beta_0 + \beta_1 X_{1it,} + \beta_2 X_{2it,} + \beta_3 X_{3it,} + \beta_4 X_{4it,} + \beta_5 X_{5it,} + \varepsilon_{it} \quad (3)$$

3.3. Data and Variable Description

This investigation utilized a board information extending from 2000 to 2019 for chose SSA nations as appeared in the Table 1. The information was acquired from World Development Indicators of the World Bank (2020) "Sustainable Energy for All (SE4ALL) database from the SE4ALL Global Tracking Framework drove together by the World Bank, International Energy Agency, the Energy Sector Management Assistance Program and World Bank". The Description of factors used in the investigation is found in Table 2.

The specific description of variables utilized in the study is found in Table 2. The table gives a description of the variables in terms of the proxies used to capture the various variables (dependent and independent) and their a priori expectation for each variable based on theory intuitions, alongside the kind of relationship that exists between each explanatory variable and the dependent variable.

4. RESULTS AND DISCUSSION

4.1. Pattern of Energy Consumption and Electricity Access in SSA

4.1.1. General access to electricity in SSA

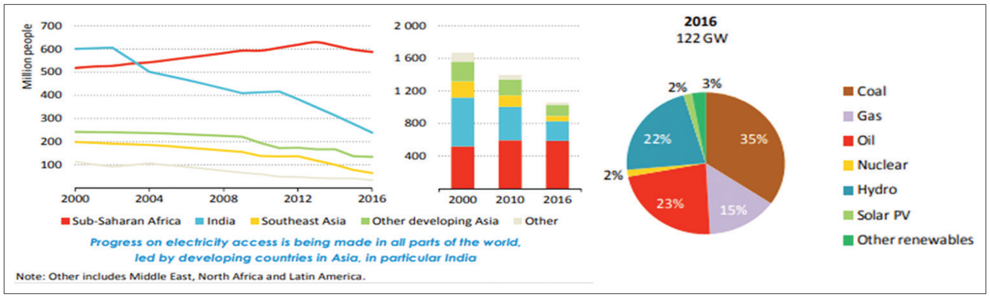
Access to electricity Africa (sub-Saharan) has particularly improved throughout the years, as seen in countries like Ethiopia, Ghana, Ivory Coast and Kenya. The pace of electrification has almost tripled between the years 2000 and 2012, and in 2014, power efforts surpassed growth for the first time as 50% SSA population do not have access to electricity making it the largest concentration of people in the world without electricity access as explained through the International Energy Agency shown in Figure 1:

SSA is becoming aware of the importance of investment in sustainable clean energy establishments as opposed to the customary enormous scope frameworks as appeared in Table 1, which depend for the most part on oil and coal. What's more, its natural advantages, renewables energy is probably going to contribute towards economic development too. ICT of energy frameworks empowers utilities to keep up lattice solidness and unwavering quality, screen the network and recognize purposes of disappointments, diminish tasks and upkeep costs, enhance and gauge energy creation and broaden the operational lifetime of benefits (Bloomberg, 2017; OECD, 2005) (Table 3).

4.1.2. Summary of Africa's energy pool generation

With around 48 nations in SSA, 21 nations have an all-out capacity generation of under 200 Mega Watts. South Africa (SA) produces 45% of the mainland all out power age while North Africa creates 30% and the remainder of Africa (48 out of 54 nations) creates 25%. Normal jolt level situations at 24% which is the most minimal in creating nations. As a rule, about 25% of the created energy is inaccessible at some random time. Force blackouts in days out of every year are as per the following: Burundi (144), Tanzania (63), Senegal (25) days while Continental normal is 56. In West Africa, generators utilized as back-up provisions represent 17% of intensity created and this is because of successive blackouts. SSA is the main area on the planet where per-capita get to rates are diminishing. As of late, over 60% of SSA will in any case need access to power by 2020 with the expense of Electricity progressively costly in SSA contrasted with different pieces of the world. Electrical matrix operational misfortunes are around 23% contrasted with

Figure 1: Population without access to electricity by region and installed capacity generating capacity in Africa (sub-Saharan) and other regions by fuel



Source: International Energy Agency, 2017.

Table 1: Description of selected SSA countries

Central African countries	East African countries	Southern African countries	West African countries
1. Angola	1. Burundi	1. Botswana	1. Benin
2. Cameroon	2. Comoros	2. Eswatini	2. Burkina Faso
3. Central African Republic	3. Eritrea	3. Lesotho	3. Cape Verde
4. Chad	4. Ethiopia	4. Namibia	4. Ivory Coast
5. Democratic Rep of Congo	5. Kenya	5. South Africa	5. Gambia
6. Rep of Congo	6. Madagascar		6. Ghana
7. Equatorial Guinea	7. Malawi		7. Guinea
8. Gabon	8. Mauritius		8. Guinea Bissau
9. Sao Tome and Principe	9. Mozambique		9. Liberia
	10. Rwanda		10. Mali
	11. Seychelles		11. Mauritania
	12. South Sudan		12. Niger
	13. Tanzania		13. Nigeria
	14. Uganda		14. Senegal
	15. Zambia		15. Sierra Leone
	16. Zimbabwe		16. Togo

Source: Authors' computation

Table 2: Variables and apriori expectation

Variable	Proxy	Relationship	Expected sign
Energy Consumption	Energy Consumption	Not applicable	N.A
Information Communication Technology	Mobile Technology	Direct	Positive
Institutions	Human capital quality, public administration, property rights and rule-based government and business regulatory environment.	Indirect	Positive
Energy Intensity	Energy Intensity	Direct	Positive
Economic growth	GDP growth rate	Indirect	Positive
Trade openness	Trade	Indirect	Positive

Source: Authors' computation

the worldwide normal of 10% with just 10% of the populace approaching lattice influence, 75% of these are rich individuals. Under 2% of the country populaces of Malawi, Ethiopia, Niger, and Chad approach electrical force (Othieno and Awange, 2016).

4.2. Econometric Analysis

The study confirms from the Pooled OLS result in Table 4 the viability of the Household ICT adoption – Energy Consumption hypothesis in SSA. The results in terms of general significance shows a good overall fit for the model as well as joint significance. This is shown by the value of the R Squared, Adjusted R Squared and the F statistic. The R Squared and Adjusted R Squared are acceptable due to the fact that they lie between 0.1 and 0.5 as acceptable for any standard panel dataset. The F-statistic is acceptable because its probability value (P value) is significant at 5% significance level (<0.05).

The findings are shown in Tables 5 and 6 also confirms the findings in Table 4 of a positive and significant relationship on the ICT - energy consumption nexus in sub-Saharan countries. The individual statistical significance shows that in SSA, further confirms the viability of the ICT adoption – Energy Consumption hypothesis statistically at 5% level of significance also. More specifically, the value of the statistically significant coefficient of mobile technology (the measure of household ICT adoption) is positive. This indicates that the adoption of such mobile technology impacts the energy utilization to further drive the economy as seen in Matthew et al. (2018); Fubara et al. (2019); Ejemeyovwi et al. (2019). This demonstrates innovative improvement because of information is basic to human turn of events (Ejemeyovwi et al., 2018; Ejemeyovwi and Osabuohien, 2018). The positive critical aftereffect of this examination is predictable with Ejemeyovwi et al. (2019).

Table 4: Pooled OLS results for ICT energy hypothesis in SSA

Dependent variable	Energy consumption	Energy consumption	Energy consumption	Energy consumption
Mobile Technology	1.45* (1.77)	1.30* (2.41)	1.36* (2.53)	1.47* (2.63)
Human Capital Quality	−31.95 (−1.28)			
Public Administration		2.24 (0.06)		
Property Right and Rule-Based Government			−25.27 (−0.83)	
Business Regulatory Environment				−24.8 (−0.98)
Energy Intensity	10.31* (2.67)	11.05* (3.90)	10.05* (3.73)	10.38* (4.11)
Gross Domestic Product Growth Rate	−1.61 (−0.46)	−2.55 (0.98)	−1.87 (−0.53)	−2.09* (−0.60)
Trade	0.39 (0.67)	0.64* (0.98)	0.45 (0.75)	0.37 (0.59)
F-statistics	5.22	4.84	5	5.06
Prob. > F	0.0002	0.0004	0.0003	0.0003
R Squared	0.1448	0.1358	0.1396	0.14
Adj R Squared	0.1171	0.1077	0.1117	0.11
Root MSE	183.33	184.29	183.89	183.73

Table 5: LSDV results for ICT energy hypothesis in SSA

Dependent variable	Energy consumption	Energy consumption	Energy consumption	Energy consumption
Mobile technology	0.36* (2.30)	0.47* (3.46)	0.52* (3.75)	0.49* (3.63)
Human capital quality	20.37 (1.65)			
Public administration		25.9 (1.45)		
Property right and rule-based government			-11.79 (-0.55)	
Business regulatory environment				9.72 (0.60)
Energy intensity	3.08 (0.88)	2.44 (0.71)	1.58 (0.47)	1.56 (0.46)
Gross domestic product growth rate	-3.40* (-4.24)	-3.73* (-4.49)	-3.29* (-3.89)	-3.48* (-4.27)
Trade	0.27 (0.99)	0.24* (0.87)	0.15 (0.53)	0.23 (0.84)
F-statistics	5.22	194.19	191.60	191.68
Prob> F	0.0002	0.0000	0.0000	0.0000
R Squared	0.1448	0.96	0.96	0.96
Adj R Squared	0.1171	0.96	0.96	0.96
Root MSE	183.33	37.88	38.13	38.12
No. of Obs	160	160	160	160
Year Dummies	Yes	Yes	Yes	Yes
Region Dummies	Yes	Yes	Yes	Yes

Table 6: REM and FEM results for ICT energy hypothesis in SSA

Dependent variable	Energy consumption		Energy consumption		Energy consumption		Energy consumption	
	FEM	REM	FEM	REM	FEM	REM	FEM	REM
Mobile technology	0.36* (2.30)	0.38* (2.45)	0.47* (3.46)	0.48* (3.62)	0.52* (3.75)	0.54* (3.94)	0.49* (3.63)	0.51* (3.79)
Human capital quality	20.37 (1.65)	19.46 (1.62)						
Public administration			25.94 (1.45)	24.45 (1.40)				
Property right and rule-based government					-11.79 (-0.55)	-14.32 (20.83)		
Business regulatory environment							9.71 (0.60)	8.10 (0.51)
Energy intensity	3.08* (0.88)	3.92 (1.62)	2.44 (0.71)	3.45 (1.09)	1.58 (0.47)	2.62 (0.84)	1.56 (0.46)	2.73 (0.88)
Gross domestic product growth rate	-3.40* (-4.24)	-3.40* (-4.28)	-3.73* (-4.49)	-3.71* (-4.52)	-3.29* (-3.87)	-3.25* (-3.88)	-3.48* (-4.27)	-3.46* (-4.29)
Trade	0.27 (0.99)	0.30 (1.09)	0.24 (0.87)	0.27 (0.99)	0.15 (0.53)	0.17 (0.58)	0.23 (0.84)	0.26 (0.94)
Wald chi2		32.19		31.45		29.65		29.27
Prob> chi2		0.0000		0.0000		0.0000		0.0000
F-statistics	217.71		219.09		215.16		214.87	
Prob> F	0.0000		0.0000		0.0000		0.0000	
R Squared	0.05	0.07	0.04	0.07	0.08		0.04	
No. of Obs	160	160	160	160	160	160	160	160
Corr (U, X)	0.11		0.10		0.17	0	0.10	0
Hausman Test	0.95		0.96		0.97		0.95	

The discoveries of this investigation on the connection among ICT and energy consumption in sub-Saharan nations show comparable aftereffects of a positive relationship with Pothitou et al. (2017) which uncover a positive connection among ICT and energy consumption in the European Union nations for the two examinations. This features the most ideal approach to improve the energy part in Africa through provincial participation. Access to present day energy services is basic for financial turn of events.

5. CONCLUSIONS AND RECOMMENDATIONS

The study was enthused by the argument on the importance ICT in the energy sector. The study utilized panel data for SSA nations within the period 2000 to 2019. The study is considered vital because of the challenges SSA faces in meeting her energy demand and closing the gaps in the energy system to reduce energy poverty. This study argues that an improvement ICT utilization as well as regional cooperation will bring about improvement that will make available SSA countries end energy poverty. The investigation suggests that regional energy participation and combination is one of the most encouraging and financially savvy choices for Africa to promote the advancement of its energy segment, so as to pick up the ecological, social and monetary advantages gathering from an increasingly productive utilization of assets. Four significant advantages are related with local energy coordination: improved security of gracefully, better financial proficiency, and upgraded natural quality.

Future investigations could likewise expand this work by distinguishing extra transmission channels, especially relevant ones, through which ICT infiltration influence the activities requiring energy/electricity consumption in rural areas in the sub-Saharan regions. Another area of further research could be on the impact of institutions on the implementation and penetration of ICT in sub-Saharan regions or specific countries. Also, areas of further research could include the unidirectional relationship between ICT use, institutional policies and energy efficiency.

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REFERENCES

Akinyemi, O., Efobi, U., Osabuohien, E., Alege, P. (2019), Regional integration and energy sustainability in Africa: Exploring the challenges and prospects for ECOWAS. African Development Review, 31(4), 517-528.

Avila, N., Carvallo, J.P., Shaw, B., Kammen, D.M. (2017), The Energy Challenge in Backgrounder Series. Available from: https://www.oxfamamerica.org/static/media/files/oxfam-rael-energyssa-pt1.pdf.

Cho, Y., Lee, J., Kim, T.Y. (2007), The impact of ICT investment and energy price on industrial electricity demand: Dynamic growth model approach. Energy Policy, 35, 4730-4738.

Ejemeyovwi, J., Adiat, Q., Ekong, E. (2019), Energy usage, internet usage and human development in selected Western African countries. International Journal of Energy Economics and Policy, 9(5), 1-6.

Ejemeyovwi, J.O., Osabuohien, E.S. (2018), Investigating mobile technology adoption and inclusive growth in West Africa. Contemporary Social Science, 15(1), 48-61.

Ejemeyovwi, J.O., Osabuohien, E.S., Bowale, E.K., Abuh, O., Adedoyin, J.P. (2019), Information and communication technology adoption and innovation for sustainable entrepreneurship. Journal of Physics: Conference Series, 1378(2), 1-10.

Ejemeyovwi, J.O., Osabuohien, E.S., Johnson, O.D., Bowale, K.E. (2019), Internet usage and inclusive growth in West Africa. Journal of Economic Structures, 8(1), 15-30.

Ejemeyovwi, J.O., Osabuohien, E.S., Osabuohien, R. (2018), Investment in technology and human capital development in ECOWAS. International Journal of Economics and Business Research, 15(4), 463-474.

Fubara, S.A., Iledare, O.O., Obindah, G., Ejemeyovwi, J.O. (2019), Natural resource extraction and economic performance of the Niger delta region in Nigeria. International Journal of Energy Economics and Policy, 9(4), 188-193.

Han, B., Wang, D., Ding, W., Han, L. (2016), Effect of information and communication technology on energy consumption in China. Natural Hazards, 84(1), 297-315.

Hilty, L.M., Coroama, V., Osses de Eicker, M., Ruddy, T.F., Muller, E. (2010), The Role of ICT in Energy Consumption and Energy Efficiency. ICT-ENSURE: European ICT Environmental Sustainability Research.

Hilty, L.M., Hercheui, M.D. (2010), ICT and sustainable development. In: Berleur, J., Hercheui, M.D., Hilty, L.M., editors. What Kind of Information Society? Governance, Virtuality, Surveillance, Sustainability, Resilience. Berlin, Heidelberg, Germany: Springer.

Horner, N.C., Shehabi, A., Azevedo, I.L. (2016), Known unknowns: Indirect energy effects of information and communication technology. Environmental Research Letters, 11(10), 103001.

Houghton, J.W. (2010), ICT and the environment in developing countries: A review of opportunities a and developments. In: Berleur, J., Hercheui, M.D., Hilty, L.M., editors. What Kind of Information Society? Governance, Virtuality, Surveillance, Sustainability, Resilience. Berlin, Heidelberg, Germany: Springer. p236-247.

Ishida, H. (2015), The effect of ICT development on economic growth and energy consumption in Japan. Telematics and Informatics, 32, 79-88.

Kramers, A., Höjer, M., Lövehagen, N., Wangel, J. (2014), Smart sustainable cities; exploring I ICT's solutions for reduced energy use in cities. Environmental Modern Software, 56, 52-62.

Matthew, O.A., Ede, C.U., Osabohien, R., Ejemeyovwi, J.O., Fasina, F.F., Akinpelumi, D. (2018), Electricity consumption and human capital development in Nigeria: Exploring the implications for economic growth. International Journal of Energy Economics and Policy, 8(6), 8-15.

Pothitou, M., Hanna, R.F., Chalvatzis, K.J. (2017), ICT entertainment appliances' impact on domestic electricity consumption. Renewable and Sustainable Energy Reviews, 69, 843-853.

Romm, J. (2001), The internet and the new energy economy. Resources Conservation and Recycling, 36, 197-210.

Sadorsky, P. (2012), Information communication technology and electricity consumption in emerging economies. Energy Policy, 48,

130-136.
Saidi, K., Toumi, H., Zaidi, S. (2017), Impact of information communication technology and economic growth on the electricity consumption: Empirical evidence from 67 countries. Journal of the Knowledge Economy, 8, 789-803.
Salahuddin, M., Alam, K. (2015), Internet usage, electricity consumption and economic growth in Australia: A time series evidence. Telematics and Informatics, 32, 862-878.
Schulte, P., Welsch, H., Rexhäuser, S. (2016), ICT and the demand for energy: Evidence from OECD countries. Environmental and Resource Economics, 63(1), 119-146.
Shahbaz, M., Sbia, R., Hamdi, H., Ur Rehman, I. (2014), The Role of Information Communication Technology and Economic Growth in Recent Electricity Demand: Fresh Evidence from Combine Cointegration Approach in UAE, MPRA Paper No. 53226. p1-30.
Shahiduzzaman, M., Alam, K. (2014), Information technology and its changing roles to economic growth and productivity in Australia. Telecommunication Policy, 38, 125-135.
Takase, K., Murota, Y. (2010), The impact of IT investment on energy: Japan and US Comparison in 2010. Energy Policy, 32, 1291-1301.
The European Commission E-Business Watch. (2008), The European E-Business Report: A Portrait of E-Business in 10 Sectors of the EU Economy; Office for Official Publications of the European Communities: Luxembourg.
Tsaurai, K., Chimbo, B. (2019), Information and communication technology (ICT) led tourism growth nexus in transitional markets. Œconomica, 15(5), 38-56.
Zhang, C., Liu, C. (2015), The impact of ICT industry on CO_2 emissions: A regional analysis in China. Renewable and Sustainable Energy Reviews, 44, 12-19.
Zheming, Y., Rui, S., Zhiming, Y. (2018), ICT development and sustainable energy consumption: A perspective of energy productivity. Sustainability, 10, 1-15.
Zhou, X., Zhou, D., Wang, Q. (2018), How does information and communication technology affect China's energy intensity? A three-tier structural decomposition analysis. Energy, 151, 748-759.