

Exploring innovative energy infrastructure financing in Ghana: benefits, challenges and strategies

Innovative
energy
infrastructure

Augustine Senanu Kukah and Andrew Anafo

*Department of Construction Technology and Management, Kwame Nkrumah
University of Science and Technology, Kumasi, Ghana*

Richmond Makafui Kofi Kukah

Department of Computer Science, University of Ghana, Accra, Ghana

Andrew Victor Kabenlah Blay Jnr

*Department of Management Studies, University of Education Winneba,
Winneba, Ghana*

Dominic Benson Sinsa

*Department of Construction Technology and Management,
Kwame Nkrumah University of Science and Technology, Kumasi, Ghana*

Eric Asamoah

Eternal Brains Data Consult, Kumasi, Ghana, and

David Nartey Korda

*Department of Construction Technology and Management,
Kwame Nkrumah University of Science and Technology, Kumasi, Ghana*

Received 10 December 2020
Revised 10 May 2021
24 May 2021
Accepted 30 May 2021

Abstract

Purpose – Inefficiencies in the power sector resulting from underinvesting and underselling reduce the ability of governments to adequately finance energy projects. The purpose of this paper is to explore mechanisms of energy financing, benefits and challenges associated with innovative financing of energy infrastructure as well as strategies to improve innovative financing of energy infrastructure.

Design/methodology/approach – Questionnaires were used to elicit responses from respondents. Seventy-eight responses were retrieved. Mean score ranking, Kruskal–Wallis test and discriminant validity were the analysis conducted.

Findings – Partial credit guarantee; partial risk guarantee; credit enhancement; and loan guarantees were the significant mechanisms. Production efficiency; reduce pressure on public budgets; access to management expertise; and self-sustainability of infrastructure facilities were the significant benefits. Lack of transparency and adequate data for risk assessment; high up-front cost; heterogeneity, complexity, and presence of a large number of parties; and lack of a clear benchmark for measuring investment performance were the severest challenges. Complete transparency and accountability; political stability and public view on private provision of energy infrastructure services; and macroeconomic environment were the significant strategies.

Practical implications – This study is beneficial to energy sector as the current government of Ghana hints on willingness to involve private sector in management of the power sector.



The authors would like to thank Mr. Nicholas Sarpong Sarfo for his help in data collection for the study.

Originality/value – The novelty of this study is that it is a pioneering study in Ghana on innovative financing of energy infrastructure.

Keywords Challenges, Strategies, Benefits, Questionnaire survey, Energy infrastructure, Innovative financing, Mean score ranking

Paper type Research paper

1. Introduction

The provision of efficient, affordable and reliable infrastructural services is an essential requirement for economic growth and sustainable development (Canning and Pedroni, 2008; Owusu-Manu *et al.*, 2020). The lack of a reliable energy supply and its inefficiencies comes at a huge cost (Ipin and Ercan, 2021). There is about 2%–4% economic growth reduction attributed to power shortage and has adverse effects on key economic sectors. About \$24bn was lost by Ghana's economy between 2010 and 2015 because of the energy crisis (Yeboah and Opere, 2018).

Innovative financing is vital to Africa's energy deficit (Sackey *et al.*, 2020). Various governments on the continent have domestically been funding energy infrastructure projects from government budgets, pension funds and sovereign bonds (Africa Progress Panel, 2015). Resource mobilisation from utility charges and taxes, however, account for about 80% of the total energy spending, it has been reported that Africa governments allocated \$6bn for financing energy infrastructure projects in 2016 (Yeboah and Opere, 2018). There is, however, a huge gap between allocation and actual expenditure. About 75% of the allocation is known to go into operation and maintenance (O&M) and not into investment. Consequently, only about 0.5% of gross domestic product (GDP) representing about \$8bn go into investment annually (International Energy Agency, 2014). This is woefully inadequate to extend power access and enhance business operations significantly. Some governments, therefore, have resorted to sovereign debt financing to organise extra resource for energy infrastructure (International Energy Agency, 2014).

Inefficiencies in the power sector resulting from underinvesting in O&M and underselling reduce the ability of various government on the continent to adequately finance energy project. It is established that these inefficiencies coupled with political patronage and institutionalised corrupt practices cost the region about 8 billion dollars yearly (Asiedu, 2002). Addressing opacity in utility management, corruption, and illicit financial flow has become critical as billions of dollars in revenues are lost yearly. In 2012 alone, it was reported that Africa lost \$69bn from the illicit financial flow, a figure which is more than the estimated \$66bn needed to meet energy and climate adaptation needs of the region (Yeboah and Opere, 2018).

Nearly half of the energy sector infrastructure investment comes from domestic public financing while external funding including official development finance (ODF), Chinese investments and private participation in infrastructure (PPI) constitute the rest (Owusu-Manu *et al.*, 2008). Again, the less developed capital market of Ghana offers very limited or no long-term financing alternatives for investors involved in infrastructure projects (Badu *et al.*, 2013). Because of the high-interest rate on capital and the lack of access to flexible domestic loans, some independent power producers (IPP) resort to foreign loans at the bear of a foreign exchange risk. These situations demoralise private participation in the energy sector investments. Creating a safe investment environment that will enhance private participation and at the same time attaining affordable electricity tariff have been a hard nut for several Africa countries (United Nations Economic Commission for Africa, 2011).

It is against this backdrop that this study seeks to explore mechanisms of innovative financing, challenges confronting innovative financing of energy infrastructure in Ghana,

benefits of innovative financing and propose strategies to improve private sector participation in the sector.

2. Literature review

2.1 Historical overview of infrastructure financing in Sub Saharan Africa

In the background of post colonisation and an economic convention which propagated accretion of capital as being the pathway to economic transformation between the 1950s and 1970s, most Sub-Saharan Africa (SSA) countries recognised infrastructure as a sector of significance. Permitted through satisfactory outward circumstances ensuing from an upsurge in commodities, SSA governments invested seriously in the infrastructural sector (Mengistu, 2013). The trend, however, suffered a retrogress in the 1980s as a result of a debt crisis, fallen commodity prices, and the inability of countries in the region to secure supplementary loans for financing infrastructural projects for development (Farooki, 2012; Mould, 2012). There was a popular belief around the time by the international development community that, infrastructure could be financed by the private sector under a certain market condition in which case the countries and their development partners can concentrate on developing other economic sectors. However, the condition was not conducive to the private sector of the SSA countries owing to constraints like a deficiency in advanced technology required for lowest verge for production and lower densities in population which made the cost for the provision of infrastructure network exorbitant. Furthermore, governance deficits and conflict in the region created a cloud of private investment risk which made it unattractive to potential investors (Mould, 2012; Jerome, 2011; Foster *et al.*, 2008). Consequently, the existing infrastructure stock weakened as investments were not forthcoming. Subsequently, SSA countries lagged behind most developing countries by the early 2000s in terms of infrastructure endowment and the infrastructure gap was considerably huge and hence poor economic growth (Foster *et al.*, 2008).

2.2 Traditional financing sources

2.2.1 *Domestic public funding.* The lack of energy access in Africa presents a daunting challenge to the development of Africa and limits economic opportunities (International Energy Agency, 2014). Traditional financing approach which the continent has relied on for the provision of infrastructure has generally been the *domestic public funding* mechanisms through budgetary allocation, taxes and rates and various donor support. However, this has been very much inadequate although it forms a major percentage of the total investments made in energy infrastructure on the continent (International Monetary Fund, 2014). According to International Monetary Fund (2014), domestic public investment constituted 72.9% or 59.4 billion dollars of the total Africa infrastructure financing in 2012 and encouragingly the governments of Africa have averagely increased their investment on infrastructure especially energy infrastructure. In recent years, infrastructure budget allocation to the energy sector has grown to about 5% according to Infrastructure Consortium to Africa, Infrastructure Consortium for Africa (2014). The energy sector enjoyed 37% of budget allocation in 2013, being the second highest to the 41% of the transport sector in the same year (Infrastructure Consortium for Africa, 2014). External financing constitutes the complementary percentage to the domestic financing discussed above. The three main external funding sources include ODF, Chinese investments and PPI (Sy and Copley, 2017).

2.2.2 *Commercial banks.* The commercial banks also provide an avenue for debt financing. However, they are comparatively often seen as the least attractive financing instrument in the pool of the corporate bond financing and European Investment bank (EIB)

loans. This alludes to its relatively short maturities of an average between 5 and 10 years, a figure that will not be favourable to energy infrastructure projects refinancing requiring economic lifetime between 20 and 50 years (European Commission, 2011). The short-term lending characterised by the commercial banks' loans may be more suitable for privatisation and acquisition contrasting the long-term bond issuance for financing concessions and PPPs (World Economic Forum, 2010).

2.2.3 Multilateral Development Banks. Multilateral Development Banks (MDBs) have the task of the provision of financial assistance and professional advice on economic and social developmental activities in developing countries; and an important financing source for energy infrastructure projects (World Bank and AfDB, 2011). They include the four major regional development banks – ADB, AfDB, EBRD, IADB; banks from the World Bank Group and other international financial institutions like the Nordic Investment Banks (NIB), EIB.

2.2.4 Capital markets. According to Irving and Manroth (2009), most infrastructure financing characteristically starts from a bank loan during the construction phase with medium-term maturity and then follow up with a long maturity term refinancing from the capital market as the project begins to generate revenue that can source repayment of debt financing. Capital markets thus provide long-term financing, unlike the bank lending. The equity market and the bond market are known to be capital markets. The bonds have relatively long maturity period of about ten years on the average (European Commission, 2011). Ghana was successful in issuing a sovereign bond on the international capital market in 2007. Since then, the country has issue series of bonds in aid of raising fund for infrastructure projects including energy resources and road construction.

2.2.5 Grants. In some instance known as “Equity support” is usually given to ease difficulties in raising required equity for projects. It is issued on specific conditions of assisting the private sector take up specific projects which on their own would not be financially inadequate to execute (European Commission, 2011). Again, grants help in acquiring capital in a form of debt from banks as the banks would typically require seeing about 20%–40% commitment in equity from developers before they provide the rest (Mould, 2012). Energy grants in Europe are organised through the European Energy Programme for Recovery (EEPR) and the Trans-European Networks for Energy (TENE) programs (European Commission, 2011).

2.3 Contemporary innovative financing approach

As governments were challenged on providing funding for infrastructure delivery from the limited public funds, alternative financing arrangements were sort after, and Innovative financing (IF) came into existence (Badu *et al.*, 2012). Consequently, it was used through private involvement in infrastructure provision. According to Badu *et al.* (2013), IF sources have been a major supplement to traditional financing sources. IF approaches have hence become a reliable option for addressing current and future infrastructural needs (Owusu-Manu, 2008).

2.3.1 Private sector participation. As the necessitation for finding alternative means of funding the provision of infrastructure intensified as a result of growing demand for utility services and the need to replace or maintain ageing infrastructure, various governments on the continent began considering the need to bring the private sector on board. The energy sector, specifically the power sub-sector has for years been public dominated hence reforms were needed for the smooth integration of the private sector. Reforms towards privatisation and public-private partnership (PPP) were sort. PPP, however, have appeared more acceptable politically than privatisation as the public need is combined with private

resource and capabilities to create a market resource through which both the public need and the private investor's goal are achieved ([United Nations Economic Commission for Africa, 2011](#)).

PPP has been the major option in the power sector through which private sector participation and other financing and management assistance are channelled ([Owusu-Manu et al., 2020](#)). Although private investment in infrastructure is not a new trend, the experience for parties involved has proven to be challenging. It was reported by [Woodhouse \(2005\)](#) in 2005 how private infrastructure investment in developing economies declined from \$46bn–\$15bn between 1996 and 2003. In recent years, further reforms have been made by the electricity sector in many countries to intensify PPPs in order to meet the growing demand for power. In Ghana, the government has hinted about its willingness to involve a private investor in the management of Electricity Company of Ghana (ECG), news that was welcomed with the 'expected' contention. However, through proper reforms and sensitisation, the introduction of the private sector expertise and financial support may not be a wrong decision considering the challenges of the ECG.

2.3.2 Potential new sources of funding for Africa's infrastructure. Partially new funding sources for infrastructure are essential for Africa. Since the 1970s' high inflation, world's interest rate has tumbled, and Africa is no exception. Currently, a large amount of capital looks for higher yields other than those of the OECD countries. The extension of maturities for local currency debt and the securitisation of sovereigns such as Ghana and Mozambique are major trends ([Africa Economic Outlook, 2018](#)).

2.3.2.1 Sovereign wealth fund. Globally managing \$7.2tn, SWFs operate out of sixty countries. Africa's share amounts a small but growing share of \$1.6bn. These funds although have mandates that favour infrastructure development, are yet to featured much in infrastructure. The economic climate of the fund over some few years now have not been favourable as the funds are based on sovereign wealth such as oil and commodity prices ([Africa Economic Outlook, 2018](#)).

2.3.2.2 International bond market. The Eurobond market presents an opportunity for infrastructure funding. A successful entry by Ghana bond issued in 2007 has been a reason for an increase in Africa entrant fuelling low public debt and rapid domestic growth in the region and low international interest rate ([Africa Economic Outlook, 2018](#)).

2.3.2.3 Foreign direct investment. About 70% of private capital investment in Africa comes in the form of FDI, as it is considered one of the least volatile forms of investment. Mineral resources including oil and gas attract most of the investment flows but there are some PPP arrangements in the power sector for infrastructure enhancement ([Africa Economic Outlook, 2018](#)).

2.3.2.4 Pension funds. One highly valuable potentially untapped source for infrastructure financing is the pension fund. Although the funds are risk-averse, the savings enjoy high liquidity and returns can be high. Although returns can be high, pension funds accrue only a small share of Africa Infrastructure investment.

2.4 Approaches to financing energy infrastructure projects

Corporate financing (CF) or project financing (PF) structures are the most used approaches in financing capital-intensive projects like energy infrastructure. For private infrastructure financing, cooperate finance has been the main channel for financing. Investors and developers range from diversified cooperation to professional businesses. Increasing budget constraints, however, have increased the popularity and adoption of Project finance ([Organisation for Economic Co-operation and Development, 2015](#)). *Project Finance* involves the financing of long-term infrastructure built upon limited recourse financial structure

where the project equity and debt generated to finance the project is paid back from the cash flow from the project. This approach has become the financial solution to public involving as a counterparty in infrastructure projects. PF has been a unique technique in attracting private capital. PF in energy infrastructure is said to be costly and complicated in its financial and organisational modes (Visconti, 2013). Looking at it from the organisational end, separate debt and equity are required for every individual project. In other words, PF characterises financing of a clearly delineated project, an economic unit or a standalone (Weber and Alfen, 2010). Financing a broader group of projects, therefore, becomes complex. Risk sharing is assigned based on the various levels of ability to control and manage risks. Contributed equity capital influences liability (Organisation for Economic Co-operation and Development, 2015).

Corporate finance has been a preferred approach in financing most of the domestic power and gas transmission projects especially among the European Union (EU) member states (European Commission, 2011). Projects adopting CF secure better financing conditions easier as projects are financed from the project company's balance sheet and loans are not related to a specific individual project. Again, payment of interest is generated through revenues of a broader group of projects and thus guaranteed. Moreover, as a large quantum of funds is secured for a group of projects at a single time, transaction costs are reduced (European Commission, 2011).

2.5 Private participation in infrastructure as innovative approach

According to the World Bank (2013), an infrastructure is a PPI if a private investor or company accepts a part of the projects' operating risk. PPI, therefore, involves a partnership between a private and the public sector in a bid to provide an increase in infrastructure stock, quality and performance through a contractual agreement.

PPI is a strategy employed to lift efficiency in operation, maintenance and long-term asset lifecycle management. It could be in the form of mobilisation of private capital from commercial loans, in a form of PPPs. For a given project, the private sector, brings financial expertise, efficiency, self-sustainability of utilities and improved services. The public sector, provides investor protection, access to credit and enabling business environment (Kirkpatrick *et al.*, 2006).

Again, a good regulatory environment is essential for a PPI success, as there are natural monopoly features in the infrastructure sector (Kirkpatrick *et al.*, 2006). Without credit enhancement or guarantee from multilateral agencies or the government, PPIs may not be achievable. As the infrastructure sector involves obtaining some upfront investment into construction during the initial stages with long run profits, the non-existence of strong credit market to deliver debt financing prospects to the private sector will be a challenge (Shirley, 2007).

2.6 Challenges to the innovative financing of energy infrastructure projects

Notwithstanding the rising importance and popularity of innovative financing on the continent, it still faces constraints that hamper or obstruct its successful implementation and adoption (Badu *et al.*, 2012). The following are some of the challenges to innovative financing in the energy sector.

2.6.1 Heterogeneity and complexities in contracts. Contractual arrangements involved in project financing are enormously multifaceted and most times takes long negotiations and laborious documents to complete (Chan *et al.*, 2009). These complexities in structuring in most cases increase the upfront fee. Project financing poses a higher risk to lenders than the traditional approach resulting in a characteristic high cost of capital (Chan *et al.*, 2009). Chan *et al.* (2009) contend that the private sector has the propensity of inflating investment in a

non-competitive bidding process as there is information asymmetry that alludes to the benefit of the private sector than the public sector.

2.6.2 High up-front cost. Infrastructures generally have high construction up-front cost. The eventual proceeds from the operating project could even not be substantial alluding to the initially high capital cost regardless of lower operating cost throughout the lifetime of the project. The various government on the continent frequently cannot cover the up-front cost of construction and the private sector investor is deterred to invest during the initial phases as a result of regulatory and contractual uncertainties ([International Energy Agency, 2014](#)). The only private financing option in such cases is the risky and expensive developer equity. Addressing the cost of financing for the initial stages of a project is quite crucial for the involvement of more private sector investment ([Sy and Copley, 2017](#)).

2.6.3 Lack of transparency. Risk assessment and mitigation plans are crucial to any credible investor. Ideally, a private investor would want to rely on the conditions and historical information or data of known contracts to build a formidable conviction of participating in a similar or the same venture. However, situations where there is the non-existence of such information or are classified lead to struggle and put investors off. Because of the lack of transparency and the high level of discretion enjoyed by politicians in the sub-region, traditional funding agencies have found a way of setting some conditionalities to counterweight for enhanced fund allocation ([Mengistu, 2013](#)).

2.6.4 Currency risk. Currency risk may arise when there is asset-liability currency mismatch. For instance, a power generation plant in Ghana financed in dollars and may have the electricity tariffs in cedis. In an instance where the cedis depreciates against the dollar by say 10%, the liability moves 10% higher as revenues remain unchanged. This creates what is known as an asset-liability mismatch. A party that can assume a risk at the most minimum cost or is in the best position to bear the risk is optimally allocated a risk in PPP. In some situations, none of the involving parties may be in a good position of bearing the risk. The ability of a typical private-sector developer to influence exchange rate does not exist. Unhedged currency risk, therefore, may be very much beyond the manageable abilities of both parties ([Mengistu, 2013](#)).

2.7 Benefits of infrastructure financing

The impact of investments may vary in the approach used in financing the investment, the form of infrastructure established and the business cycle timing of the investment ([Stupak, 2018](#)). Benefits of infrastructure can be put into two main categorisations: the economic benefits and the social benefits.

2.7.1 Effect on economic output. When there is a higher level of economic output as a result of a bigger stock of public capital, then it falls into the long-term expectations of the economists ([Kumi, 2017](#)). Expansion or increase in infrastructure such as electricity, road enhances output in both short and long terms allowing businesses and individuals to be more efficient and productive. Such efficiency and productivity conserve time for engaging in other activities that could generate added economic output. For example, a speed rail infrastructure from Accra to Tamale of Ghana could shorten the time for commuting by road thereby allowing the quick delivery of goods to consumers and even at a lower cost ([Kumi, 2017](#)). Such quick delivery of goods and services will translate into economic growth as it literally means an increase in productivity, a key determinant of economic growth.

2.7.2 Effect on employment. When there is a positive change in economic output, there are at least some employment changes that come with it. The economies that produce more goods and services require an equivalent number of people as actors of production and vice versa – Okun's law ([Knotek, 2007](#)). A decrease in economic growth shows an increase in the rate of

unemployment. The opposite occurs when there is an increase in economic growth. Kumi (2017) reported of how the erratic power supply of Ghana some few years ago resulted in the fold up of some companies and a corresponding increase in unemployment rate.

3. Methodology

This research adopted the quantitative strategy by using survey questionnaire to elicit data from respondents. The choice for the quantitative approach is informed by the researchers' desire to quantify the opinions of respondents in the sector using the positivist approach (Baiden, 2006). This study used a survey research design as it best served to answer the questions and purpose of the study (Burns and Grove, 2001; Bryman and Cramer, 2005).

In this study, the population was people with energy project financing knowledge or expertise in Ghana, comprising energy policy analysts, non-governmental energy organizations, energy consultants, MSc Energy and Sustainable Management postgraduate students in Ghana. The stratified simple random sampling technique was adopted and a sample size of 78 respondents was obtained.

Questionnaires were the instruments for data collection. The questionnaire designed for the study was subjected to validation process for content validity. During the validation process, copies of the questionnaire with the research questions were given to some faculty members. These faculties went through the questionnaire and the research question to establish the aptness and adequacy of the instrument. Consequently, suggestions for modifications and inclusions were received from these faculties and were adhered to. Having validated the questionnaire, a pilot testing of the instrument was carried out using some members of energy efficiency advisors who were at a workshop at Council for Scientific and Industrial Research (CSIR), Accra. Actual distribution spanned a period of three weeks and questionnaires were personally distributed by the researchers to the respondents and persistent follow ups undertaken to retrieve the filled questionnaires.

Questionnaires retrieved were analysed and interpreted after entering the data into Microsoft Excel and the Statistical Package for the Social Science (SPSS) software. Analytical tools consisted of descriptive statistics, Kruskal–Wallis test and mean score ranking. Reliability and validity tests were also conducted.

4. Data analysis and discussion

4.1 Validity and reliability test statistics

This section sought to ascertain the reliability and validity of the responses received with the Likert scale by assessing the internal consistency using the Cronbach's alpha coefficient. Table 1 presents the reliability statistics. Cronbach's alpha coefficient should exceed 0.700 for data to be reliable. The results of this study show that all the variables had Cronbach's alpha coefficient above 0.700.

On validity, the loadings of the retained items were all above 0.60 and positive and so fulfilled the requirement of convergent validity. The computed composite reliability values were all above 0.60 and that of the AVE were also all above 0.50 indicating the meeting of the acceptability level.

4.2 Innovative financing mechanisms associated with financing energy projects

In the attempt to establish the mechanism commonly used in the innovative financing of energy infrastructure projects in Ghana, respondents were asked to rank from a list gathered from literature. The extent of agreement to the various mechanisms by the respondents was analysed and ranked by way of their mean scores and respective standard deviations. Table 2 presents the results.

Innovative
energy
infrastructure

Constructs/measures	Loadings (<i>t</i> -values)
<i>Financing mechanisms (CA = 0.835, CR = 0.930, AVE = 0.702)</i>	
FM1	0.659
FM2	0.893
FM3	0.884
FM4	0.635
FM5	0.659
FM6	0.892
<i>Benefits of innovative financing (CA = 0.901; CR = 0.911; AVE = 0.724)</i>	
BIF1	0.887
BIF2	0.901
BIF3	0.726
BIF4	0.789
BIF5	0.748
BIF6	0.689
BIF7	0.891
BIF8	0.902
BIF10	0.689
<i>Challenges of energy financing (CA = 0.904; CR = 0.913; AVE = 0.725)</i>	
CEF1	0.789
CEF2	0.825
CEF3	0.864
CEF4	0.727
CEF5	0.776
CEF6	0.767
CEF7	0.863
CEF8	0.725
CEF9	0.783
CEF10	0.764
<i>Innovative financing strategies (CA = 0.897; CR = 0.899; AVE = 0.629)</i>	
IFS1	0.747
IFS2	0.818
IFS3	0.823
IFS4	0.786
IFS5	0.812
IFS6	0.756
IFS7	0.814
IFS8	0.823
IFS9	0.779
IFS10	0.800
IFS11	0.825
IFS12	0.772
IFS13	0.809

Notes: CA = Cronbach's alpha; CR = Composite reliability; AVE = Average variance extracted

Table 1.
Validity and
reliability test results

Partial credit guarantee (PCG) had the highest rank and thus can be inferred as the most used mechanism for delivering innovative energy infrastructure projects in Ghana. PCG is a guarantee given for repayment of a part of the total debt in case of default. This mechanism is used by several countries to support their PPPs programs. Multilateral agencies like the World Bank also use PCG in most of their financial assistance to countries. The government

usually provide these guarantees in support of private parties who acquire lending from a commercial source. In the case of default by the private party, the government accepts paying a part of the total amount. Some school of thought contend, guaranteeing projects could undermine the risk transfer to the private sector (Farquharson *et al.*, 2011).

4.3 Benefits associated with innovative financing of energy infrastructure

To give credence to why governments should explore the innovative ways of financing energy infrastructure, there was the need to establish if there are any benefits as envisaged. Respondents were thus asked to rank from a list of benefits collated from literature to indicate the level of significance, using a five-point Likert scale: 1 denoting “Not significant” and 5 denoting “Very significant”. Analysis was by mean scores and standard deviations. Table 3 presents the results.

Production Efficiency was ranked 1st. It can thus be inferred that production efficiency is one of the top-most benefits associated with the innovative financing of energy projects in Ghana. There is a general perception amongst most Ghanaians that state-owned and managed enterprises are not as productive as they should be. Conversely, privately owned co-operations are believed to be more efficient and productive. However, the relationship between private sector involvement and performance improvement in terms of efficiency is complex and as a result has not been comprehensively assessed (Obadan, 2008). Organisation for Economic Co-operation and Development (2015) argues, however, that, regardless of the inadequate data and methodological difficulties, there is substantial support for the notion that privatisation significantly increases profitability, efficiency and real output of privatised companies. Respondents of this study strongly agree with the general notion.

Reduces pressure on the public budget was ranked 2nd. In Ghana where public utilities and state enterprises absorb substantial portions of government budget yearly, privatisation may free public resources for sustained development.

Access to management expertise was ranked 3rd. Some researchers opine that the cliché that government would be successful if it were to be run by the private sector with the standard business management practices is not entirely so. Private sector managers are concerned with creating added value, but managers in government often know what to do and desire to do but are faced by restrictions of laws, regulations, policies and directives that prevent prompt action (Mares, 2013). However, Panayotou (2000) contends, the increase in calls for private sector participation in infrastructure and public-sector provision is catalysed by poor performances and mismanagement characterising publicly owned and operated utilities. It can be said that a partnership between the two in a form of PPP should foster some balance.

Respondents of this study rated “self-sustainability of infrastructure facilities” 4th. As in Ghana’s situation, Panayotou (2000) contends privatisation is comparable to subsidy

Table 2.
Mechanisms for
delivering innovative
financing

Mechanisms	Mean	SD	Kruskal–Wallis test (<i>p</i> -value)	Ranking
Partial credit guarantee	3.354	0.79	0.665	1
Partial risk guarantee	3.292	0.82	0.875	2
Credit enhancement	3.271	0.71	0.991	3
Loan guarantees	3.167	0.69	0.865	4
Euro bond	3.104	0.93	0.654	5
Green bond	2.542	0.98	0.851	6

reduction and enhanced cost recovery especially in situations where state enterprises are inefficient or make losses. The private entity providing service will try to recover the cost by charging users for its use and would be cost reflective. However, as services like electricity and water are seen as more “public” and comes with various forms of subsidy, efforts to involve the private sector in its management are more likely to be received with scorn. That notwithstanding, the private entity is likely to elicit the preferences of the users as to type and level of services and willingness to pay for it more than the public enterprise. Charging cost reflective tariff for services like electricity, water and even fuel means better cost recovery, reduced budget deficit and larger public-sector savings, better service provision and coverage expansion.

4.4 Challenges associated with financing energy infrastructure projects

It was imperative to consider the challenges faced by various players in energy infrastructure projects financing, as overcoming these constraints would provoke the participation interest of the private sector and enhance effective and sustainable energy infrastructure delivery. Participants were requested to rate the level of severity of each of the identified challenges from literature using a modified five-point Likert scale with 1 representing “Not very severe”, 5 representing “Very severe”. Table 4 presents the results.

It is not surprising that respondents of this study ranked lack of transparency and adequate data for risk assessment 1st out of the ten challenges posed to them with a mean of 3.771. The lack of transparency in every system creates a breeding room for corruption. Risk assessment and mitigation plans are crucial to any credible investor. Ideally, a private investor would want to rely on the conditions and historical information or data of known contracts to build a formidable conviction of participating in a similar or the same venture. However, situations where there is the non-existence of such information or are classified lead to struggle and can discourage private investors. Corruption, according to Mengistu (2013) is prevalent in SSA. Consequently, as a result of the lack of transparency and the high level of discretion enjoyed by politicians in the sub-region, traditional funding agencies have found a way of setting some conditionalities to counterweight for enhanced fund allocation. Interestingly to a varying degree, the levels of transparency of the fund agencies, especially the bilateral agencies, are also questionable in relation to how funds are disbursed to developing countries as assistance for development (International Aid Transparency Initiative – IATI, 2013).

Benefits	Mean	SD	Kruskal–Wallis test (<i>p</i> -value)	Rank
Production efficiency	4.063	0.69	0.236	1
Reduce pressure on public budgets	4.000	0.65	1.000	2
Access to management expertise	3.896	0.63	0.028	3
Self-sustainability of infrastructure facilities	3.688	0.82	0.394	4
Increases access to financing of energy infrastructure	3.604	0.86	0.128	5
Offer an alternative to the traditional source of funding	3.438	0.84	0.556	6
Align cost-effective decisions	3.333	0.57	0.483	7
Enable innovation	2.729	0.49	0.834	8
Reduce overall asset cost	2.458	0.54	0.214	9
Ease in resolving financial disorder	2.354	0.56	0.924	10

Table 3.
Benefits associated
with innovative
financing of energy
infrastructure
projects

Challenges	Mean	SD	Kruskal–Wallis test (p -value)	Rank
Lack of transparency and adequate data for risk assessment	3.77	0.72	0.867	1
High up-front cost	3.64	0.65	0.213	2
Heterogeneity, complexity, and presence of a large number of parties	3.58	0.63	1.000	3
Lack of a clear benchmark for measuring investment performance	3.47	0.79	0.548	4
Lack of liquidity	3.43	0.66	0.592	5
Currency risk	3.39	0.61	0.842	6
Lack of access to lifecycle support	3.29	0.67	0.098	7
Lack of coordination amongst funders	3.16	0.66	0.651	8
Lack of dedicated resource on the part of investors	2.60	0.88	0.912	9
Lack of investor protection	2.39	0.61	0.461	10

Table 4. Challenges associated with financing energy infrastructure projects

High upfront cost ranked 2nd by respondents, high upfront investment can be said to be one of the major challenges with financing energy infrastructure projects in Ghana. Energy infrastructure projects such as building an oil refinery, as has been the wish of the Ghanaian Government, is capital intensity and characterised with high up-front costs. Consequently, the lack of liquidity and the longevity of the project life stimulates the need for substantial and dedicated financial resources on the part of investors as well as understanding the risks. Although infrastructure projects tend to generate stable cash flow once they are into the operational phase, it is saddled with high risks and pre-development and construction costs during the initial stages. This could deter investors especially when the assessments identified no credit guarantee. Government intervention would be vital in creating investment value.

Heterogeneity, complexity and presence of a large number of parties was ranked 3rd amongst the tested ten challenges. Owing to the uniqueness in nature of infrastructure facilities, they tend to be heterogeneous and come with complex legal measures designed to safeguard appropriate distribution of payoffs and risk-sharing to rationalise incentives of all involving parties. The structure and latent complexity make energy infrastructure investments less liquid (Organisation for Economic Co-operation and Development, 2015). Contractual arrangements involved in project financing are enormously multifaceted and most times takes long negotiations and laborious documents to complete. These complexities in structuring in most cases increase the upfront fee (Chan *et al.*, 2009). Again, the complexities of tasks and the varied number of parties involved make management of financial transactions difficult and required careful management. As a result, project financial transactions delay extending scheduled years of different phases of the project.

4.5 Strategies to improve innovative financing of energy infrastructure projects

Respondents were asked to rank the level of significance of the strategies to improve innovative financing on a 1 to 5 modified Likert scale with 1 being least significant and 5 being most significant. Table 5 presents the results.

Complete transparency and accountability was the highest ranked factor with a mean of 4.208 and a standard deviation of 0.771. The lack of transparency and accountability which breeds corruption has been mentioned by Transparency International as the major challenge across the Africa continent. It is, therefore, hardly surprising that complete

Strategies	Mean	SD	Kruskal–Wallis test (<i>p</i> -value)	Rank
Complete transparency and accountability	4.21	0.771	0.932	1
Political stability and public view on private provision of energy infrastructure services	4.14	0.831	0.211	2
Macroeconomic environment	3.89	0.692	0.028	3
Consumers' ability to pay for services	3.87	0.761	0.312	4
Project risk allocation	3.85	0.850	1.000	5
Competitive bidding processes	3.83	0.63	0.283	6
Adequate regulatory framework and proper enforcement of laws	3.81	0.89	0.183	7
Government effectiveness and responsiveness	3.71	0.84	0.453	8
Institutional capacity to regulate PPPs	3.60	0.64	0.424	9
Independence of regulatory institutions and processes	3.50	0.77	0.512	10
Expansion of capital market	3.50	0.77	0.512	10
Access to credit	3.43	0.82	0.293	12
Structural characteristics of a country	3.17	0.83	0.618	13

Table 5.
Strategies to improve
innovative financing
of energy
infrastructure
projects

transparency and accountability has been ranked by respondents as the highest factor that will influence the private sector participation in energy infrastructure provision.

Political stability and public view on private provision of energy infrastructure services ranked 2nd by the respondents. A corresponding study by [Foster and Briceño-Garmendia \(2010\)](#) found politically unstable countries attracting less private investment into infrastructure unlike the more stable ones in SSA. Some infrastructure like electricity and water are characteristically considered 'public utility' and often receive some form of subsidies, consequently, any form of private participation is likely to be received with some backlash as the private sector would want to rationalise tariff. To some extent, however, the opinion of the public may be influenced by the public officials in power. If the majority of the public believe and support the ideologies of the government in power, the PPI arrangement may be viable. Again, this variable was reported by [Lamech and Saeed \(2003\)](#) to influence the attraction of PPI, but to a lesser extent than has been ranked by respondents of this study. The high ranking attributed to this factor partly may have been influenced by a recent decision made by the government of Ghana to involve the private sector in the management of ECG and the reactions it received from both workers of ECG and a section of the public.

Macroeconomic environment was ranked as the 3rd most significant factor for private participation in energy infrastructure provision. Enabling environment has been severally mentioned in literature as a key factor for PPI success. [Banerjee et al. \(2006\)](#) have revealed that inflation coupled with exchange rate erraticism in not favourable to PPI. However, findings made by [Mengistu \(2013\)](#) in a study of PPI investment in low and middle-income countries in Africa suggest that, while in principle PPI investment is expected to be stimulated by factors like low tax burden on private sector and more stable macroeconomic environment, large PPI investments in SSA go to countries with corrupt and inefficient governments.

Consumers' ability to pay for service was ranked 4th by respondents and forms an integral part of investors decision-making. Every investor expects returns on investment made, as such, it eminent that infrastructure projects that are required by legislation that users do not pay, or by regulation that they pay unreflective and fewer tariffs for its use, have clear-cut government interventions to mitigate the cost to meet investors' return expectations.

5. Conclusions

From the mean score ranking, PCG; partial risk guarantee; credit enhancement; loan guarantees and euro bond were the most significant mechanisms for delivering innovative financing. Production efficiency; reduce pressure on public budgets; access to management expertise; self-sustainability of infrastructure facilities; and increases access to financing of energy infrastructure were the most significant benefits associated with innovative financing of energy infrastructure projects. The most severe challenges associated with financing energy infrastructure projects were ranked to be lack of transparency and adequate data for risk assessment; high up-front cost; heterogeneity, complexity and presence of a large number of parties; lack of a clear benchmark for measuring investment performance; and lack of liquidity. Complete transparency and accountability; political stability and public view on private provision of energy infrastructure services; macroeconomic environment; consumers' ability to pay for services; project risk allocation were the most significant strategies to improve innovative financing of energy infrastructure projects.

This study was limited to stakeholders in Ghana. There is the likelihood of significant variations in the research findings if conducted in other geographical and economic jurisdictions. However, the agreement of the findings with literature goes on to establish credibility and trust in these findings.

Empirically, the robust and rigorous identification of mechanisms, challenges, benefits and strategies regarding innovative energy infrastructure in the current study have useful theoretical, practical and wider implications. Notably, a study combining and bringing out all the pertinent topics in innovative financing of energy infrastructure is lacking and this study fills that gap. Theoretically, the research constitutes the first exclusive assessment of the generic, significant themes in financing energy projects. From a theoretical lens, the output of the research contributes to the checklist of mechanisms, challenges, benefits and strategies and may contribute to the development of innovative finance theories. Practically, the identified and prioritised strategies will serve as a guide and managerial support in future energy projects. Policy wise, the study is beneficial to energy sector as the current government hints on the willingness to involve the private sector in the management of the ECG by Power Distribution Service (PDS). The study is expected to be of importance to academia and subsequently form an origin of motivation for further study in the area.

References

- Africa Economic Outlook (2018), "Financing Africa's Infrastructure: New Strategies, Mechanisms, And Instruments", OECD Development Centre.
- Africa Progress Panel (2015), "Power People Planet' Africa Progress Report", Geneva.
- Asiedu, E. (2002), "On the determinants of foreign direct investment to developing countries: is Africa different?", *World Development*, Vol. 30 No. 1, pp. 107-119.
- Badu, E., Owusu-Manu, D., Edwards, D.J. and Holt, G.D. (2013), "Analysis of strategic issues underpinning the innovative financing of infrastructure within developing countries", *Journal of Construction Engineering and Management*, Vol. 139 No. 6, p. 34.
- Badu, E., Edwards, D.J., Owusu-Manu, D. and Brown, D.M. (2012), "Barriers to the implementation of innovative financing (IF) of infrastructure", *Journal of Financial Management of Property and Construction*, Vol. 17 No. 3, pp. 253-273.
- Baiden, B.K. (2006), "Framework for the integration of the project delivery team", Unpublished Thesis (PhD), Loughborough University.
- Banerjee, S.G., Oetzel, J. and Ranganathan, R. (2006), "Private provision of infrastructure in emerging markets: do institutions matter?", *Development Policy Review*, Vol. 24 No. 2, p. 175.

-
- Bryman, A. and Cramer, D. (2005), *Qualitative Data Analysis with SPSS 12 and 13: A Guide for Social Scientists*, Routledge, London, p. 63.
- Burns, N. and Grove, S.K. (2001), *The Practice of Nursing Research Conduct, Critique and Utilization*, 3rd ed., W. B. Saunders, Philadelphia.
- Canning, D. and Pedroni, P. (2008), “Infrastructure, long-run economic growth, and causality tests for cointegrated panels”, *The Manchester School*, Vol. 76 No. 5, pp. 504-527.
- Chan, C., Forwood, D., Roper, H. and Sayers, C. (2009), “Public infrastructure financing: an international perspective”, Productivity Commission Staff Working Paper.
- European Commission (2011), “The structuring and financing of energy infrastructure projects, financing gaps and recommendations regarding the new Ten-E financial instrument tender”, Final Report, Directorate-General for Energy, Berlin/Brussels, available at: http://ec.europa.eu/energy/infrastructure/studies/doc/2011_ten_e_financing_report.pdf (accessed 24 January, 2020).
- Farooki, M. (2012), “The infrastructure and commodities interface in Africa: time for cautious optimism?”, *Journal of International Development*, Vol. 24 No. 2, pp. 208-219.
- Farquharson, E., Torres de Mästle, C. and Yescombe, E.R. (2011), “How to engage with the private sector in public-private partnerships in emerging markets”, The World Bank, Washington, DC.
- Foster, V. and Briceño-Garmendia, C. (2010), “Africa’s Infrastructure: A Time for Transformation”, Agence Française de Développement and the World Bank, Washington, DC, p. 64.
- Foster, V., Butterfield, W. and Chen, C. (2008), “The changing landscape of infrastructure finance in Africa: non-traditional sources take on a growing role”, World Bank Public-Private Infrastructure Advisory Facility (PPIAF), Washington, DC.
- Irving, J. and Manroth, A. (2009), “Local sources of financing for infrastructure in Africa: a cross-country analysis”, Policy Research Working Paper 4878, The World Bank Africa Region, African Sustainable Development Front Office, available at: www.iaa.org/publications/freepublications/publication/english.pdf (accessed 26 February, 2020).
- Infrastructure Consortium for Africa (2014), “Infrastructure financing trends in Africa: ICA report 2014”, Tunisia: ICA Secretariat, Africa Development Bank, available at: www.icafrica.org/fileadmin/documents/Annual_Reports/infrastructure_financing_trends_in_africa_%e2%80%93_2014.pdf (accessed 27 April 2019).
- International Energy Agency (2014), “Africa Energy Outlook: A Focus on Energy Prospect in Sub Saharan Africa”, October Issue, International Energy Agency, Paris.
- International Monetary Fund (2014), “Sub Saharan Africa: Staying the Course; World Economic and Financial Survey: Regional Economic Outlook – REO”, October. Washington, DC, p. 65.
- İpin, S. and Ercan, T. (2021), “Financing hydroelectric power plants: a review and evaluation of financing channels”, *International Journal of Energy Sector Management*, Vol. 15 No. 1, pp. 58-80.
- Jerome, A. (2011), “Infrastructure, economic growth and poverty reduction in Africa”, *Journal of Infrastructure Development*, Vol. 3 No. 2, pp. 127-151.
- Kirkpatrick, C., Parker, D. and Zhang, Y. (2006), “Foreign direct investment in infrastructure in developing countries: does regulation make a difference?”, *Transnational Corporations*, Vol. 15 No. 1, p. 143.
- Knotek, E.S. (2007), “How useful is Okun’s law?”, *Federal Reserve Bank of Kansas City Economic Review*, Vol. 92 No. 4, pp. 73-103.
- Kumi, N.K. (2017), “The electricity situation in Ghana: challenges and opportunities”, CGD Policy Paper, Center for Global Development. Washington, DC.
- Lamech, R. and Saeed, K. (2003), “What international investors look for when investing in developing countries results from a survey of international investors in the power sector”, Energy and Mining Sector Board Discussion Paper, No. 6.

-
- Mares, J. (2013), *25 Differences between Private Sector and Government Managers*, Power publication, Washington, DC.
- Mengistu, T.M. (2013), *Emerging Infrastructure Financing Mechanisms in Sub Saharan Africa*, RAND Cooperation publications, Santa Monica, CA, p. 2.
- Mould, A. (2012), “Will it all end in tears? Infrastructure spending and African development in historical perspective”, *Journal of International Development*, Vol. 24 No. 2, pp. 237-254.
- Obadan, M.I. (2008), *The Economic and Social Impact of Privatisation of State-Owned Enterprises in Africa*, Council for the Development of Social Science Research in Africa, Dakar, Senegal, Oxford.
- Organisation for Economic Co-operation and Development (2015), “Privatising state-owned enterprises”, Paris, available at: www.oecdilibrary.org/content/_book/9789264104099-en (accessed 17 May 2020).
- Owusu-Manu, D., Badu, E. and Edwards, D.J. (2008), “Conceptual paradigm and rethinking project finance strategy for highway projects financing in Ghana”, *PentVars Business Journal*, Vol. 3 No. 3, pp. 85-93.
- Owusu-Manu, D., Kukah, A.S., Boateng, F., Asumadu, G. and Edwards, D.J. (2020), “Exploring strategies to reduce moral hazard and adverse selection of Ghanaian public– private partnership (PPP) construction projects”, *Journal of Engineering, Design and Technology*, doi: [10.1108/JEDT-05-2020-0195](https://doi.org/10.1108/JEDT-05-2020-0195).
- Panayotou, T. (2000), *The Role of the Private Sector in Sustainable Infrastructure Development*, Harvard Institute for International Development.
- Sackey, D.M., Owusu-Manu, D.-G., Asiedu, R.O. and Jehuri, A.B. (2020), “Analysis of latent impeding factors to solar photovoltaic investments in Ghana”, *International Journal of Energy Sector Management*, Vol. 14 No. 4, pp. 669-682.
- Shirley, M. (2007), *Urban Water Reform: What We Know, What We Need to Know*, Ronald Coase Institute, St. Louis, MO.
- Stupak, J.M. (2018), “Economic Impact of Infrastructure Investment”, Congressional Research Service: CRS Report R44896.
- Sy, A. and Copley, A. (2017), “Closing the Financing Gap for African Energy Infrastructure: Trend, Challenges, and Opportunities. Brookings Institution, Africa Growth Initiative.
- United Nations Economic Commission for Africa (2011), “Strengthening Public-Private Partnerships in the Electricity Sector in West Africa”, Addis Ababa.
- Visconti, R. (2013), “Evaluating a project finance SPV: combining operating leverage with debt service, shadow dividends and discounted cash flows”, *International Journal of Economics, Finance and Management Sciences*, Vol. 1 No. 1, pp. 9-20.
- Weber, B. and Alfen, H.W. (2010), *Infrastructure as an Asset Class: Investment Strategies, Project Finance and PPP*, Wiley, Chichester.
- World Economic Forum (2010), “Paving the way: maximizing the value of private finance in infrastructure”, World Economic Forum USA Inc, 3 East 54th Street, 18th Floor, New York, NY 10022 New York, USA, available at: www3.weforum.org/docs/WEF_IV_PavingTheWay_Report_2010.pdf (accessed 2 June, 2020).
- Woodhouse, E.J. (2005), “Political economy of international infrastructure contracting: lessons from the IPP experience”, Working Paper No. 52, 27-68, available at: http://pesd.fsi.stanford.edu/sites/default/files/PESD_IPP_Study%2C_Global_Report.pdf (accessed 20 March 2019).
- World Bank (2013), “Africa Infrastructure Knowledge Program: Handbook on Infrastructure Statistics”, available at: www.infrastructureafrica.org/ (accessed 20 May 2020).
- World Bank and AFDB (2011), “Africa infrastructure knowledge program: handbook on infrastructure statistics”, available at: www.infrastructureafrica.org/ (accessed 20 May 2020).
- Yeboah, S. and Opore, K.B. (2018), *Optimizing Innovative Finance in Africa’s Energy Sector*, BBN Times publication.

Further reading

- Brealey, R., Cooper, I. and Habib, M. (1996), "Using project finance to fund infrastructure investments", *Journal of Applied Corporate Finance*, Vol. 9 No. 3.
- Foster, V., Butterfield, W., Chen, C. and Pushak, N. (2009), "Building Bridges: China's growing role as infrastructure financier for Sub-Saharan Africa", The World Bank, Public-Private Infrastructure Advisory Facility (PPIAF), Washington, DC.
- Gutmen, J., Sy, A. and Chattopadhyay, S. (2015), "Financing African Infrastructure: can the world deliver?", The Brookings Institution, Washington, DC.
- Liu, T. and Wilkinson, S. (2011), "Adopting innovative procurement techniques: obstacles and drivers for adopting public private partnerships in New Zealand", *Construction Innovation*, Vol. 11 No. 4, p. 452.
- Mould, A. (2012), "Will it all end in tears? Infrastructure spending and African development in historical perspective", *Journal of International Development*, Vol. 24 No. 2, pp. 237-254.
- Neville, C. (2007), *Introduction to Research and Research Methods, Effective Learning Service*, Bradford University School of Management.
- Sanghi, A., Sundakov, A. and Hankinson, D. (2007), "Designing and using public-private partnership units in infrastructure: lessons from case studies around the world", Gridlines, Note, No. 27.
- Taylor-Powell, E. and Steele, S. (1996), "Collecting Evaluation Data: an Overview of sources and methods, Program Development and Evaluation", G3568-4, University of Wisconsin Extension.
- Wilson, D.I., Pelham, N. and Duffield, C.F. (2010), "A review of Australian PPP governance structures", *Journal of Financial Management of Property and Construction*, Vol. 15 No. 3, pp. 198-215.

Corresponding author

Augustine Senanu Kukah can be contacted at: augustinekukah@gmail.com