

# Public-private partnership in Ghana's solar energy industry: The history, current state, challenges, prospects and theoretical perspective

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## ABSTRACT

Public Private Partnerships (PPPs) have been used as a viable tool to accelerate infrastructural development in many countries. In recent years, the repercussions of climate change have heightened the need to adopt cleaner energy sources such as solar. Ghana has attempted investments in solar energy for obvious advantages such as ensuring energy security, cost advantage and expansion of rural electrification. PPPs have been adopted in various sectors of Ghana's economy including transport, construction, education, energy and health but the extent of success is arguable. This paper throws light on the history, current state, the challenges and prospects of the solar sector in Ghana. Issues such as accountability and transparency, tensions due to land litigation, politicisation of PPPs and poor bargaining abilities due to low knowledge of PPP agreements are established in this paper as hindrances to PPPs in Ghana. Indeed, Ghana has a huge prospect for solar energy and if PPPs are treated as a 'Game' of fairness or with the 'Parito Optimality' notion rather than with an 'altruistic incline', investor confidence may potentially rise. It is also recommended that, the current national policy on PPP under Ghana's Ministry of Finance and Economic Planning (MOFEP) must be enhanced and implemented fully in order to boost investor confidence in the solar sector.

## 1. Introduction

The quest to boost the adoption of solar energy in Ghana is unrivalled hence various attempts have been made in the past by policy makers to expedite this. Solar has helped in rural electrification especially in off-grid communities, provision of cleaner energy option to replace traditional biofuel and offered competitive cost advantages [1]. The drive to find alternative clean energy to augment efforts in the climate change fight has led to the full adaptation of solar. Interestingly, the passive idea of solar can be likened to the beginning of mankind, when the sun was a major source of heat and light [2]. Before photovoltaics (PV), the ancient man relied heavily on the sun for various activities not limited to drying, heating, and lighting, which makes it incontrovertible that solar is a hoary epiphany.

In the early 5th century BC, the Greeks started exploring modes of capturing the sun's heat for warming their buildings. This idea was further developed by the Romans by using transparent materials to replace their windows just to save the heat captured during the day. Fast forward

to the 19th century, solar technology started gaining roots in parts of Europe and the US. Currently, solar technology has been fully explored for domestic and industrial use [3] with various public and private entities commercializing it for the wide reach of the general public. Solar technology has been developed further into water purification pumps, air conditioners, heaters, light, television sets, radios, Among a host of other domestic and industrial appliances [4]. Solar for electrification has become essential, especially to help the fight against high emission sources such as fossil fuels. The electricity system of solar usually depends on its proximity to the general grid. Off-grid, on-tied, and hybrid systems are popular types of solar configurations [5] as seen in the figure below Fig. 1.

Considering the geographical location of Ghana, it is indisputable that the country receives sunlight almost all year round [7] which makes it possible to rely on solar energy for its overall electricity needs Fig. 2. below highlights the sunshine portions across the country and gives a clear indication of the viability of solar technology in Ghana.

Solar started gaining roots in Ghana from the 1980s with specific targets in remote and off-grid communities. Basic solar panels and appli-

*List of Acronyms and Abbreviations:* BOT, Build Operate Transfer; GEDAP, Ghana Energy Development Access Project; GNDPC, Ghana National Development Planning Commission; GoG, Government of Ghana; KNUST, Kwame Nkrumah University of Science and Technology; LPG, Liquefied Petroleum Gas; PO, Parito Optimality; REMP, Renewable Energy Master Plan; SE4ALL, Sustainable Energy for All; SNEP, Strategic National Energy Plan; SREP, Scaling Up Renewable Energy Project.

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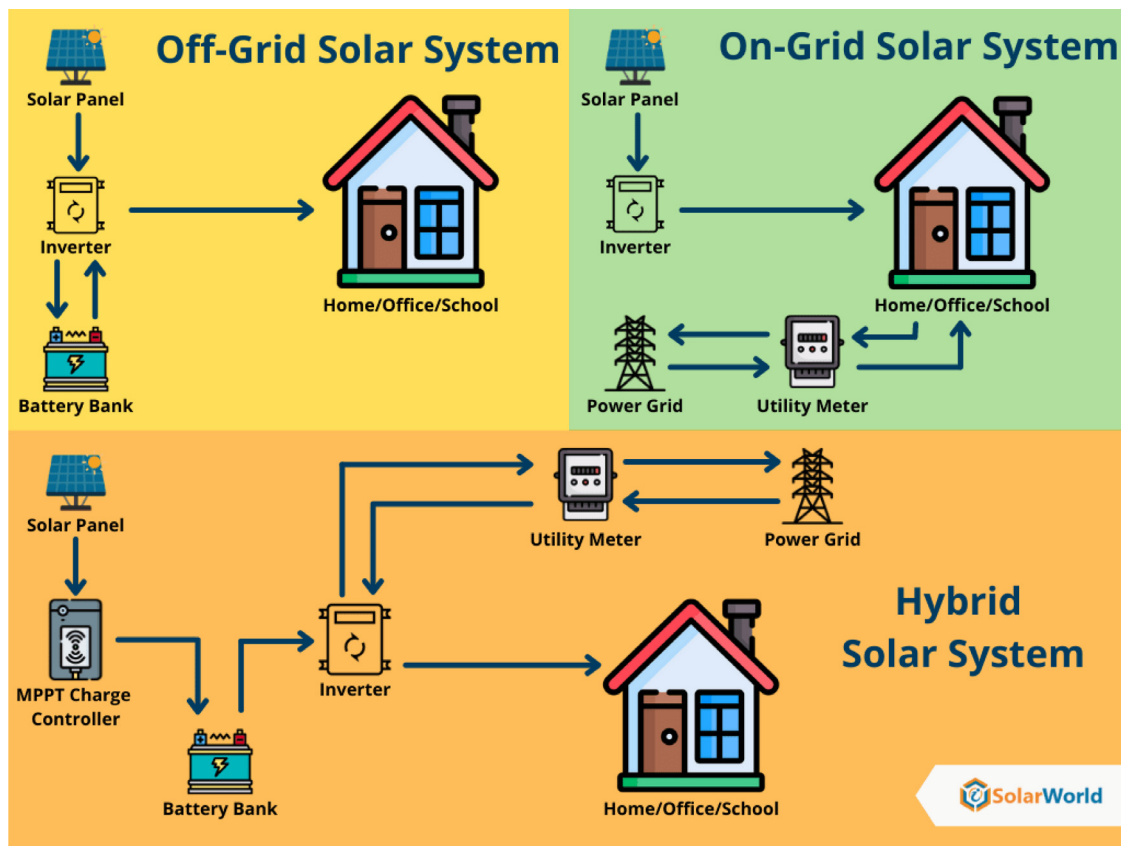


Fig. 1. Off-Grid-tied, On-Grid and Hybrid Solar System [6].

ances started gaining popularity in Ghana especially during the 2012/16 power crises; "dumsor", which brought a lot of distasteful experiences and economic hardship in the country. Although inconsistencies in electricity supply is not new to Ghanaians, the economic implications and ripple effects keeps changing, especially as many individuals and industries have gotten used to having basic electricity for their livelihood. Currently, such a great deal of appetency has been developed by Ghanaians for solar products, especially rural dwellers and off-grid communities who have very little desire to pay electric bills every month. The idea that solar has less-to-no on-going maintenance cost amidst various advantages such as its portative nature, durability, and efficiency is enough reason to hold on to it [9].

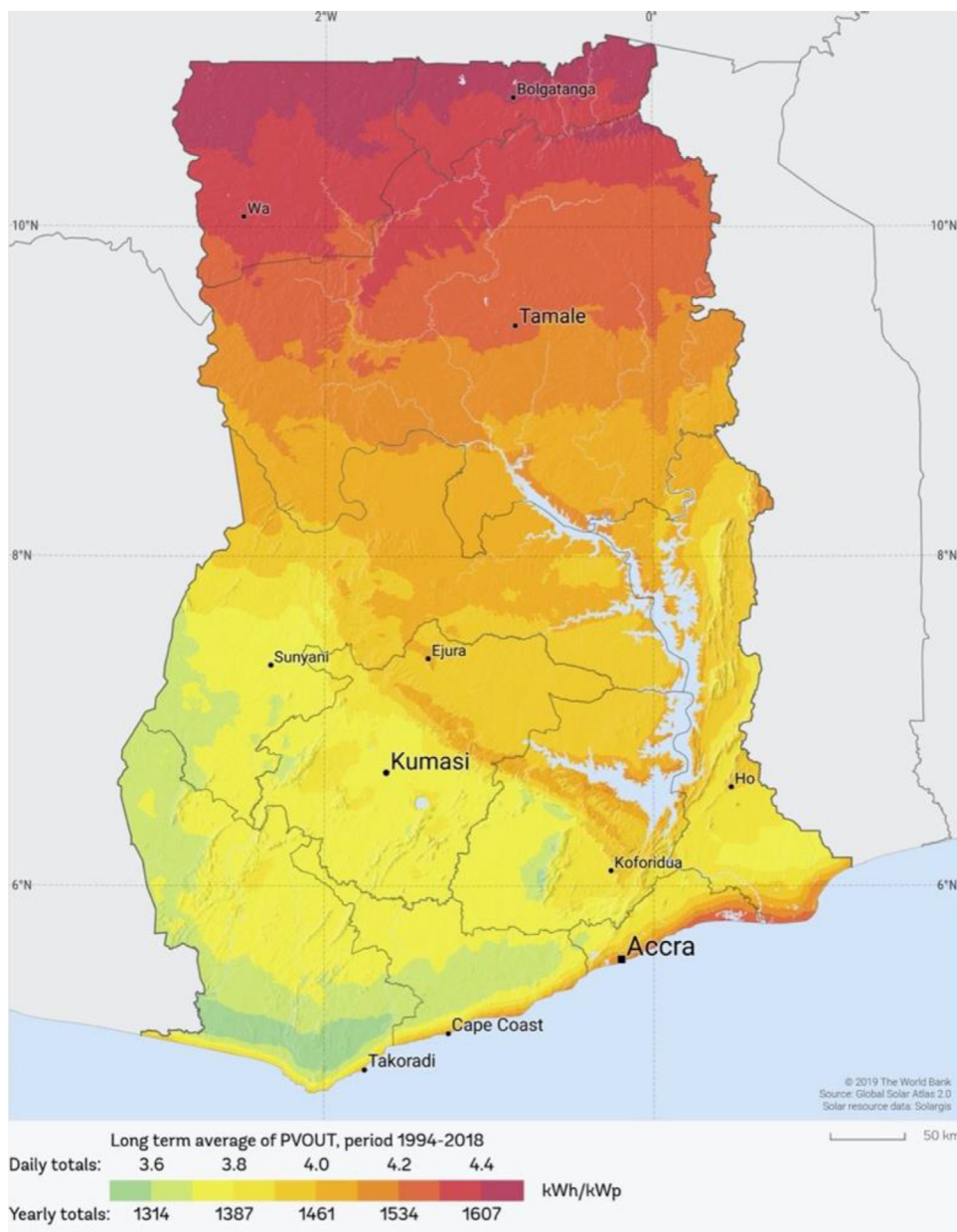
For many rural dwellers in Ghana, solar is the only electricity source known, as public facilities such as schools, churches, clinics, boreholes, and street lights rely on it for power. Electrification projects in the solar industry have gone through a steady progression from the 1990s with about 335 PV installation projects, summing up to a total capacity of about 160KW for domestic and commercial use [10] to a current level of 64 MW with other developments underway.

Interestingly, the majority of Ghanaians; both rural and urban dwellers use firewood and charcoal for domestic activities, especially cooking due to high poverty levels. This has consequences on the environment and human health apart from its high emissions which causes indoor pollution. Indeed, having access to electricity per say does not completely extenuate poverty, however, there is a direct correlation which cannot be controverted [7]. The perfect replacement for biofuels in Ghana has been liquified petroleum gas (LPG) but seems to be unpopular in many homes especially rural communities [10]. The Strategic National Energy Plan (SNEP) outlines clear measures to be considered by the government and stakeholders to help correct this dilemma but to a large extent have not been successful as it has almost exhausted its time parameters; 2006–2020 [11]. Biofuels still form the largest source

of energy for Ghanaians mainly because to a large extent it caters for the cooking and heating needs of the people. The desire to grow solar technology may potentially be an answer to the over-dependence on biofuels for cooking and heating. This is partly because solar technology has been fully explored into direct cooking and heating appliances [12] yet to be popularised on the Ghanaian market.

Although researches such as [13] opine that solar energy does not have any direct correlation with economic and GDP growth, it has still proven to be a reliable alternative and cleaner energy option for many developing countries [14]. There is a positive nexus between economic growth and CO<sub>2</sub> emissions, especially in developing countries, however, with solar energy nations are guaranteed of no CO<sub>2</sub> emissions [15,16]. These days, solar goes beyond traditional PV application on the roof tops of buildings to advance systems such as Building Integrated Photovoltaics (BIPV) [17] and further applications such as Agrovoltatics [18]. Another fundamental area where solar has penetrated is the nexus between water and energy. Several studies proves that solar reduces the energy requirement for clean water production [19–22]. The benefits are enormous; hence a considerable effort needs to made to boost its adoption.

PPPs have formed the backbone to many major solar projects in various countries. Notable among them in Africa are Morocco, Egypt and South Africa. Ghana embraced PPPs officially with an introduction of a national policy framework to guide the execution of PPPs [23]. The hope was to create room for private sector participation in projects in Ghana, especially in construction, health and energy sectors which have been side-lined for at least the last two decades [24]. It is obvious that the new hope of PPPs as the answer to infrastructural facelift in Ghana has not materialised fully yet due to less participation of the private sector. Active Private Sector Participation (PSP) has aided in giving an infrastructural facelift to many countries especially in the developing world. Indeed, there are several reasons why the private sector remains



**Fig. 2.** Solar resource map photovoltaic power potential of Ghana [8].

hesitant in investing in Ghana's infrastructure. Over the past years, the Government of Ghana (GoG) has struggled to meet all the infrastructural needs of the country, the little attempts have been sponsorships from donor parties, budgetary allocations, and other international financial institutions [25]. It is therefore imperative that the government channels energy to secure the inclusion of private sector. This paper discusses PPPs in Ghana's Solar Energy Industry, the challenges that confront its operations, and the prospects. It further gives a theoretical perspective and analyzes on the findings. The next paragraph throws light on understanding the challenges of solar energy generation and development in Ghana. The next paragraph discusses PPP's in Ghana, the history and current state. The next highlights the challenges of PPP's in Ghana. The subsequent paragraphs discuss the prospects and some theoretical perspectives. The final paragraph concludes.

## 2. Understanding the challenges of solar energy generation and development in Ghana

Ghana like many other developing countries faces a lot of challenges in the solar industry although some progress has been made in recent

times. Various approaches and strategies have been adopted to ensure the growth of the industry yet little margins can be shown forth in the energy mix of Ghana [26–29]. Solar should have been fully integrated into the energy mix of Ghana partly due to the favourable climate, but the reverse is the case. Key issues identified from various researchers have been high taxes, inauspicious policies, high cost, social problems, lock-in to hydropower and biofuel, unstable currency, grid connection problems, and lack of investment in the sector [30]. This section will discuss prominent challenges such as cost, inauspicious policies, and some social problems.

- (i) Cost has an integral role to play in the full acceptance of solar in Ghana. Over the past years, solar technology has been tagged as relatively expensive [31] until the Chinese marginalized the cost [32], thereby making it more competitive for ordinary consumers. The Ghanaian solar market however is yet to enjoy the cost marginalization to full capacity, as the unstable nature of the nation's currency leads to constant price fluctuations, mostly upwards. It could have been said a few years ago that high tax burdens increased the cost of PVs on the Ghanaian market but recent government intervention

to make solar products tax-free has altered the narrative. One would easily opine that the quest for renewable energy expansion schemes by the government such as the 'Sustainable Energy for All' (SE4ALL), 'Ghana Energy Development Access Project' (GEDAP) and 'Scaling Up Renewable Energy Project' (SREP) [33] would have moderated cost of solar products on the market, yet the opposite is the case. Comparatively, biofuels are converted to charcoal and raw firewood for cooking and heating at a relatively lower price, which makes it the most feasible option for many people especially rural dwellers. Until people are educated on the harmful effects of traditional biofuels, with alternative means adopted to beat down cost on the market, switching to an option like solar would not make sense in the mind of the average Ghanaian.

- (ii) Various attempts have been made by the government to carve favourable policies to promote a robust solar industry in Ghana, but the extent of success is debatable. The renewable energy fund and tax exemptions given to solar importers are plausible but the real impact these funds are making is the issue of concern. The problem rather may be that due to the unstable nature of Ghana's currency [34], it is torturous to trade on the international market. Policies are being held in one aspect, which is to reduce prices, yet to no avail. Ignoring areas such as empowering local technicians to be abreast with solar technology trends, the establishment of a local PV production plant, and training experts in the industry are disastrous and may contribute to a bootless attempt to integrate solar into Ghana's energy mix. On the flip side, if manufacturing is domesticated, the solar industry can be robust and fully accepted by many across the country and beyond as the high-cost factor would be addressed.
- (iii) Social-cultural problems have been spotted as a hindrance to the growth and development of Ghana's solar energy sector. The widespread and acceptance of solar partly depends on the literacy rate and basic knowledge of the technology. Until recently, about 74% of rural dwellers in Ghana were illiterates [35], yet they remained the major target for the solar market due to various rural electrification projects. It is interesting to note that many of these rural dwellers have very little or no knowledge of the existing solar technologies [36], and even if they did, they regarded it as an "out of earth" option. The average Ghanaian has little or no idea that solar can perfectly meet their energy needs [37], therefore look up solely to the conventional national grid system which is erratic. Understandably, the majority of Ghanaians are very used to traditional biomass [38] and recently fossil fuels (mainly petrol, gas and kerosene). The minds of people are naturally orientated towards these traditional energy sources. Although solar is seen as another alternative, people cannot embrace it as an alternative source they can wholly rely on Fig. 3. shows a summary of the discussed challenges above.

### 2.1. The history and current state of PPPs in Ghana

PPPs over the years have gained deep roots in various areas of Ghana's infrastructural developments, and the solar energy industry has not been left out. The overall intention of the Ghanaian government to increase her renewable energy shares to 10% by 2020 through the adoption of a Renewable Energy Master Plan (REMP) [39] has been a primary stimulant for the full expansion of solar, by making room for private sector participation.

The rudimentary stages of Ghana's solar industry saw the massive involvement of many non-governmental organizations due to the government's impassive approach to rural electrification and power sustainability. Per contra, as the paradigms in the industry shifted, with diversified technology, deliverables, and proven enduring nature of solar products in Ghana, the government's interest gradually increased and favourable policies were carved to promote solar. This gradually brought about the inception of various PPPs in direct response to policies such as tax cuts, subsidies, and other favourable economic advantages

[40]. The scaling up theory and building a solid sustainable industrial capacity especially in remote and off-grid communities has pushed the involvement of many private entities [41]. Scaling up approaches such as tax reduction, subsidizing solar products, and restructuring existing industries [42] has given solar a facelift especially in recent times.

Private solar projects were initiated mainly by NGOs and private actors as an altruistic incline, not in PPP agreements per se, but to augment government's efforts that have been made to expand electricity especially in remote and off-grid communities. These installations were mainly for hospitals, churches, and schools. Later on, the government partnered with private companies to adopt solar for major state-owned agencies such as Ghana Post, Telecom, and Cocoa board to substitute their high carbon emission diesel plants. Solar was scantily used in the 1980s and between 1991 and 2003, solar had migrated from 335 systems to 4911 systems with a capacity of 160kw to 1000kw Fig. 4. shows the solar trend history of Ghana from 1991 to 2003 [7].

After about three decades, solar has seen a massive transformation and growth in its utilization levels not just within hospitals, NGO's, and schools but through various PPP. It has become a major backbone to the development of especially rural electrification in Ghana [42]. The greatest motivation for the easy adaptation of solar is the fall in price and enhancement of the technology especially by the Chinese [43]. The scale-up of solar became imminent since the 1980s. Four key stages have been identified as significantly influencing PPPs in Ghana. First is the "Embryonic Stage" (between 1980 and 1994) [44]. This stage marks the onset of PPPs, where government hatched policies with an altruistic intent of seeking sponsorship through private actors, foreign charities, and NGO's for various solar projects Table 1. below highlights a few donors supports received by the government through aids and charity from various international communities with altruists intends. The second stage is the "Vision 2020" which was initiated by the government in 1995 to promote rural electrification through the Ghana National Development Planning Commission (GNDPC) [45], of which solar has been the most popular under this initiative. The third stage is an initiative led by the government between 2001 and 2004 which saw the inception of major solar projects through government support [46]. The final stage is the face of PPPs. This has been between 2005 and 2020, with many indicators of partnerships in the solar industry partly due to the influx of technology and price reductions [39].

Attempts by the government to promote rural electrification and poverty alleviation have been a major stimulant for the rise of solar PPP agreement as favourable policies emerged with some seemingly positive benefits to the solar industry. PPP solar agreements took roots in the Ghanaian electricity system since 2005 and have been one of the most prominent channels for major solar projects.

### 2.2. The challenges

PPP agreements in Ghana's solar industry has seen various faces of growth since its inception in the 1990s. However, various challenges have been identified to hinder its progress. Just as in many other sectors, the challenges that cripple the progress of PPPs in Ghana are hinged on the major players. The most prominent challenges identified are issues of accountability and transparency, tensions due to land litigations, Inadequate legislation governing PPPs in Ghana, low knowledge of PPP agreements, poor bargaining abilities, and politicisation of PPPs [48]. These issues have been further expounded in the subsequent paragraphs.

#### 2.2.1. Issues of accountability and transparency

In Ghana, issues of accountability and transparency run through various sectors of the economy since it forms the basics of every good governance system [47]. Various political regimes after the 4th republic have been placed in a pigeonhole of corruption and being unable to account for their spending decisions, awarding of contracts, and nepotism. The shrouded nature of how PPP agreements are carried out in Ghana makes it a complex web to approbate. Corruption is visible in various





Fig. 3. Challenges of Solar energy in Ghana (Authors own construct).

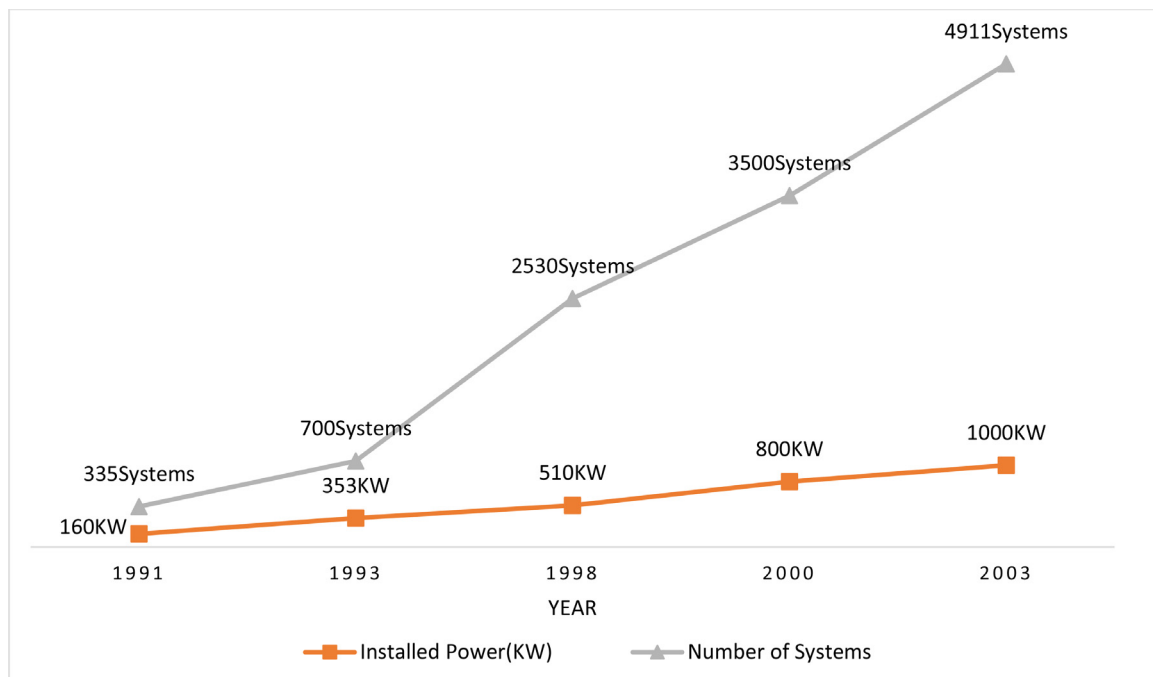


Fig. 4. History of solar installations in Ghana between 1991 and 2003 [7].

aspects of governance, even in Ghana's energy sector, where a supposed electricity deficit exists with rigorous attempts to bridge the gap [49].

Interestingly, in a 2017 survey by the Transparency International, Ghana ranked 80 out of the 180 States across the entire world in corruption [50]. This is a clear indication that corruption in Ghana is a "big deal" that requires practical proactive steps to circumvent it. Various PPPs have been marred with Political corruption, business corruption, and bureaucratic corruption [51]. In some cases, actors in solar PPP agreements are not held accountable and the entire contractual agreement process is not transparent. The criteria for awarding contracts have always been seen as selective and reserved for the "top participants who can pay". Unfortunately, many actors who tend to be awarded these contracts sometimes do not even have the capacity to execute and maintain them. This has discouraged otherwise committed investors to back-off therefore hampering growth in the sector.

#### 2.2.2. Tensions due to land litigations

Various PPPs, being it Build Operate Transfer (BOT) have been fiercely refused due to land litigation issues especially among traditional rulers, who are mostly the custodians of these "stool lands" on which projects usually sit. In Ghana, lands are owned by individuals and traditional rulers. There are instances where a private investor could double pay for the "project land" to both traditional rulers and local assembly, which can be overburdening and sometimes a big turn off to begin with. The laws on land administration in Ghana is somewhat poor, therefore leaving a loophole for litigation [52]. The government in various instances may need to step in to settle these disputes amicably, however, there are instances where there are visible disagreements between the traditional rulers over a particular piece of land. This somehow discourages an investor and tends to push them to look elsewhere.

**Table 1**

A tabulated version of some major PPP and donor-funded sola projects in Ghana. Data was sourced from [7,26,47].

DONOR	YEAR	AREA OF SUPPORT
Spanish/GoG	1998–2003	Street and Community lighting, vaccine refrigeration
UNDP/GEF	1994–2004	Installation of PV in rural communities
World Bank/GoG	1992	Off-grid solar PV for adult literacy programmes in rural communities
GTZ, Germany	1997–2000	Aid solar pumps for rural irrigation
CIDA	1992	To strengthen energy issues in Kwame Nkrumah University of Science and Technology (KNUST)
Canada	1992	Capacitate and support national development priorities
JICA, Japan	2004	Rural electrification Unisef solar in Northern Ghana
DANIDA Denmark	1999–2002	Off-grid solar electrification of 14 rural communities
BXC of FXXCE	2016	20 MW Solar Park

### 2.2.3. Inadequate legislations governing PPPs in Ghana

The scantiness of the legislations on PPPs in the Ghanaian context has caused major flops in the roll-out of various PPP agreements. The componential role of laws, which is to regulate, ensure fairness, and ensure consequentiality [53] makes it easier for private investors to come to the partnership table with the confidence of not being marginalized. The Local Assembly and various State actors in the want of a viable law, tend to dwell on 'their frameworks', mostly for their selfish gains [48]. Lack of procedure and orderliness is a discouragement for many private investors especially at the district level where most of these solar PPP agreements take place for rural electrification.

### 2.2.4. Poor bargaining abilities due to low knowledge of PPP agreements

A key challenge in PPP agreements in Ghana is the inadequacy of knowledge and negotiation expertise. The "greenness" of PPP remains after many years of its inception in the Ghanaian system. Many local assemblies who take on key solar PPP agreements especially for rural electrification have very limited knowledge in their roll-out, therefore tend to rely on their discretion and abilities. This leads to poor choices and considerations, either favouring or overburdening the investor. Due to the scanty knowledge that officials who handle these PPP agreements possess, they tend to engage in very crummy agreements, without necessarily looking out for a good bargain for the intended projects.

### 2.2.5. Politicisation of PPPs

Understandably, PPP agreements exist between the government and private actors, so it is therefore controlled and overseen by the government, mostly being the receiving party [51]. In Ghana, many PPP projects in general are controlled by various political leaders. This means the faithful "party members" or affiliates tend to win various contracts even if they do not have the pre-requisite qualification to manage the contracts. This naturally connotes that once the political party is out of office, the future of the project is affected. In many instances, projects are abandoned or underprioritized once a new government comes to power. However, politicizing every single project tends to slow down the progress of projects and discourage private investors. From various surveys, PPP agreements especially under the local assemblies have been subjected to political turmoil, and various changes are made as soon as there is a change in government which tends to destabilize ongoing projects [46]. Instead of creating fairgrounds for PPP investments to operate, contracts and agreements are made based on political bias, and not on merit or capabilities per se. Solar project beneficiaries sometimes need to be an affiliate to a particular political party to benefit from electrification projects. Unfortunately, this attitude has derailed and turned sour many PPP agreements across board.

Fig. 5 summarizes the challenges of PPP's in Ghana.

## 3. The prospects

Fundamentally, PPP has been instrumental in the development of Ghana's solar industry. Counting down from the history of solar since the 1990s [7] and how various private sector investments have pushed rural electrification [47], there is enough proof that PPP is the roadmap

to solar proliferation, especially in the rural and off-grid communities of Ghana. The electricity deficit of Ghana, which currently stands at 17.6% [54] makes it obligatory on the government to create flexible and targeted policies to help get rid of the existing gap. Indeed, to a large extent, as the need to migrate to clean energy has become incumbent due to climate change issues, the government has the onus to encourage partnerships in solar energy, which seems to be the most viable renewable energy source in Ghana.

PPP in the solar industry has great prospects in Ghana considering the rate at which solar technology is being embraced by the Ghanaian people. Traditionally, the widespread of solar was partly stalled due to its expensive nature, but these days, prices have been fairly reduced as a result of the expansion of the technology and production capacity. This has increased the appetite for solar energy to augment existing power options especially in remote and off-grid areas in Ghana. A meaningful and detailed PPP policy guide will have great impact on future PPP projects in Ghana considering the increasing infrastructural deficit especially within the energy sector, partly due to peri-urban settlements, industrialisation and population increase.

## 4. Theoretical perspective and discussions

To critically examine PPPs in the Ghanaian context, related theories such as the Altruism, Principal Agent, Game and Parity Optimality (PO) may be applicable. Ghana dwells on "aids, support, help, and gifts" all with an altruistic intention. An impression of self-pity is created to attract donors. This has been a major setback for PPPs in Ghana's solar industry as it deports private participation thereby impeding growth. Many major projects that have been executed through sponsorships such as charity and aids end up having a short life span, partly due to sustainability and maintenance. Sometimes, 'Freebies are undervalued' therefore projects received for free are not well-catered for, leaving an undesirable impression for donors. This altruistic stance tends to impede growth and infrastructural development in the solar industry directly and indirectly by discouraging private actors or hatching an unsustainable maintenance culture due to the undervalued nature of free projects. Seeing PPPs as a "Game" of fairness is rather enabling. Both actors; investors and government tend to benefit mutually without one party feeling cheated or reaped off. The Game theory promotes businesses and promotes investor confidence [55].

Also, in an instance where both the principal and agent have their interests and expectations twisted, there is a high tendency that PPP agreements will never work. The principal-agent problem can be traced in various agreements, with each party being "over cautious", for the fear of being cheated. It is in the best interest of parties to see PPPs as a ground for mutual benefit, and a game of fairness and 'win-win' to make it an applicable viable tool for development.

Another interesting perspective applicable to Ghana's case is accessing PPP's through the lens of the Pareto Optimality theory. Indeed, should the government assume a stance that treats PPPs as a mutually beneficial instrument for development and not to leave one party worst off, the narrative would be different. There is always the tendency for the government to get reluctant to fulfilling its part of the contractual agree-

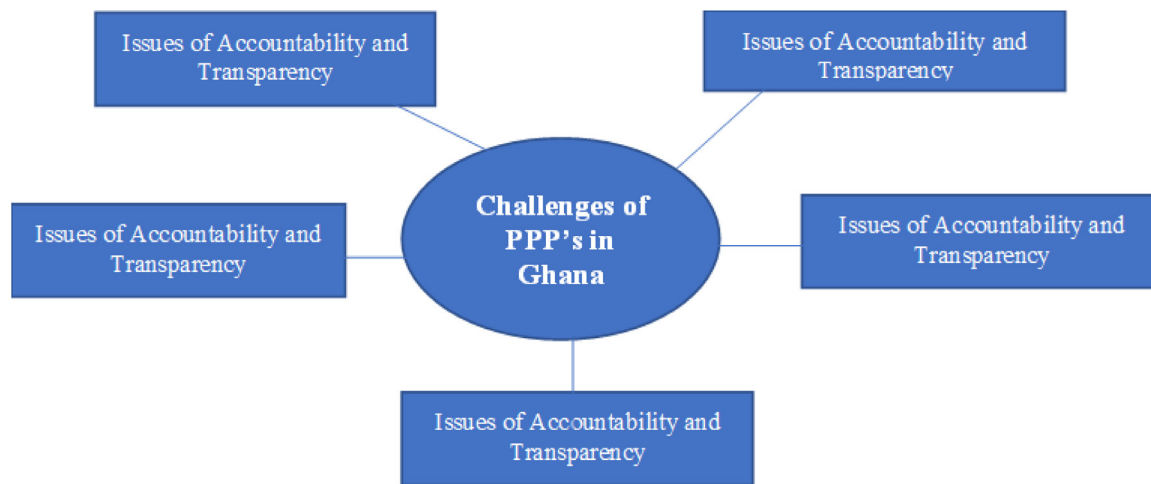


Fig. 5. Challenges of PPP's in Ghana (Authors own construct).

ment which results in ripping off the private investor, thereby leaving them worst off than the start of the agreement. In the reverse, the private actor also has the incline of maximizing profit and ripping the State off, leaving it poorer with an undeserving project in return. Indeed, the Pareto optimality theory does not exult equity and fairness, but at least one party must not be worst off. The political economy may not necessarily consider the 'morality game' but just some practical measures to help materialize ideas to bridge the infrastructural deficit gap.

## 5. Conclusion and policy implications

This paper has critically reviewed and discussed existing literatures on PPPs in Ghana with focus on the solar sector. Topics such as the history, current state, challenges and prospects have been covered. Just as many other African countries, Ghana has had its share of PPP failures and wrong practices that limits the implementation of major solar projects. The energy deficits and intermittent power crises faced by the nation could be peacefully addressed using solar energy to augment current biofuel, thermal and hydro, especially in rural and off-grid communities. It is discussed in this paper that, major problems that cause failure in PPP agreement in Ghana's solar sector are; Issues of accountability and transparency, tensions due to land litigations, inadequate legislations governing PPPs in Ghana, poor bargaining abilities due to low knowledge of PPP agreements, and politicisation of PPPs. Indeed, PPP is a useful tool for the establishment of major projects in many countries and Ghana could potentially benefit from same. It is therefore imperative that the approach towards handling PPPs is revised and the position of government shifts from an altruistic intent to a game of fairness, where both parties can mutually benefit. Ghana's solar sector will move to an enviable position should PPP be given the maximum attention it deserves in order to attract investors into the sector.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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