

The development electrification in ghana environmental sciences essay



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Introduction

Ghana in its recent past has faced difficulties in generating sufficient electricity to meet the energy requirements needed for growth and economic development (AGSI, 2011). More difficult has been the numerous communities in the country which under the electrification expansion programme which are supposed to benefit from grid connection but are situated off or remotely from the national power grid with hardly any possibilities of accessing the grid power any time soon (AGSI, 2011). The development electrification in Ghana was initiated under the National Electrification Scheme (NES) in 1989 and has since been the major policy drive in ensuring a wider access to electricity in Ghana (AGSI, 2011). With a Self Help Electrification Programme (SHEP) instituted by the government to complement the NES, the country has recently achieved an estimated 72% access rate of electricity (2011) from a lower access rate electricity rate of 15% as at 1990 (AGSI, 2011). In spite of this impressive achievement in electricity access rate in the country, quite a vast number of communities in rural Ghana (with only 27% electricity accessed) are yet to be electrified and as such are confronted with the challenges of living in off-grid areas under extreme socio-economic challenges that require urgent attention of the government (AGSI, 2011). Electricity demand for the domestic market is projected to exceed 4, 400 MW in 2020 (www.stoffstrom.org/.../2MEST). With an expanding economy and growing population, Ghana faces major challenges in providing: the required amount of energy with reliability and It is unlikely that all communities in Ghana will be electrified by 2020 if electricity supply is based on grid extension only (www.zef.de/fileadmin).

Rational of study

It has come to the reason as to why solar energy is the preferred form of alternative source of energy for Ghana. Looking at the geography and location of Ghana, and more importantly the intensity of sunlight in Ghana which has approximately 2370 hours of sunlight annually (<http://www.readandsubmitarticles.com/ghana-climate-temperature-mean-weather/>) which is very efficient for the production of solar energy as an alternative energy source for the country (Gabienu S. Francis., 2011). With the abundance of solar in the country it is still confronted with inadequacy of the energy sources and rampant erratic power outage (New African, 2007). This particular phenomenon, amongst other factors, has resulted in low productivity; low development and slow growth of the country's economy (Dovi, 2007) particularly in the rural areas. Studies have also shown that the demand of energy outweighs its supply, thus many would prefer an alternative source of energy (New African, 2007). The main objective of the report is to analyze the viability and success of a solar PV generation as an alternative source of energy for the country and its potential commercialization. It will attempt to determine what the market opportunity might be, both now and in the future; the size of the market; and market barriers; opportunities for growth and the requirements for success. The report is structure in , Section 2 Section 3 discusses Section 4 analyses sustainability issues. Section 5 Finaly some conclusions are drawn.

Overview of Solar Market in Ghana

In a globalize world full of opportunities, technology has made it possible to utilize the abundance of solar radiation in the tropical areas of Africa such as

Ghana which finds itself positioned to produce electricity from solar energy sources (AGSI, 2011). Ghana's geographical location in the tropics, solar radiation is available almost throughout the year. The country receives on average 4.0 - 6.5 kWh/m²/day of solar radiation and sunshine duration of about 1800-3000 hours per year (Ministry of Energy, 2006; Energy Commission, 2007a). Abakah (1995), lamented the fact that solar energy, although abundant in Ghana, was mostly utilized in its raw state through open sun-drying. It is estimated that about 7,000 tonnes of oil equivalent of solar energy was used in drying Ghana's cocoa beans in the year 2004 (Energy Commission, 2006b). Solar market in Ghana especially solar PV installations can be traced back to 1983 when the National Energy Board (NEB) was established (KITE/UCCEE, 1999). However solar PV electrification projects were first implemented in the early 1990's (<http://www.slideshare.net/hdevers/solar-pv>). By 1991 there were about 335 solar PV installations in Ghana with a total estimated power of about 160 Kilowatts (Institute of Economic Affairs, 1999). The implementation of the NES in 1990 influenced a sharp increase in the number of solar PV systems from 700 in 1993 to 2,530 systems in 1998. By December 2003 about 4,911 systems were installed with total installed power of 1.0 peak megawatt (MWp) (Obeng G. Y and Evers, H. D 2009). Despite this achievement, Ghana Statistical Service (2005) reported 0.2 percent for the contribution of solar energy to the total energy supply in terms of the population using solar for lighting. In more recent times Ghana has seen three (3) grid-connected solar PV systems installed for demonstration purposes, one at the Ministry of Energy (50 kWp), Energy Commission (4 kWp) and KNUST College of Engineering (4 kWp). With National Renewable Energy Law, currently under discussion, it could pave <https://assignbuster.com/the-development-electrification-in-ghana-environmental-sciences-essay/>

the way for large scale generation of grid-connected solar PV systems

(Obeng., G. Y, et at 2009). Figure 2, Historical Trend of Solar PV installation

in GhanaSource: Obeng., G. Y, et at 2009

2. 1 Solar PV Technology

Solar energy is a type of renewable energy which comes from direct sunshine. It is produced by converting the sunshine into thermal or electrical energy. There are two types of solar energy which are being used today.

These are the thermal and photovoltaic. (Solar Energy History, <http://www.go-solar.net/?s=thermal>, 2010). However the focus of report is on Solar PV.

The photovoltaic type of solar uses the process of turning energy from the sun into electrical power by using cells. These cells will change the solar energy into a direct current (DC) voltage which is usually stored in batteries and then converted into an alternating current (AC) Voltage, the type of voltage that is used to supply our homes. When solar cells turn light energy from the sun into electricity, it is then used to power equipment which uses solar power to operate, such as calculators, bulbs, radios and others.

(<http://www.go-solar.net/tag/photovoltaic-cells/>, 2010). Though solar PV systems are cost-effective alternatives for low voltage applications in remote areas, high installed system cost, lack of local market, lack of sustainable financing among others impede access widening in poor developing countries like Ghana (Sawin, 2004). The cost of PV module is declining worldwide with growing market volume and it is expected that, if wide-scale electrification programmes associated with bulk purchase of PV and economies of scale in production and sales go ahead, the costs of PV systems would decline further (Plastow and Goldsmith, 2001).

3. 0 Market Analysis

3. 1 Environmental Forces

The environment forces are analyzed using the PESTEL framework. These include political, environmental, social, technology, environment and legal/regulatory. The PESTEL provides a comprehensive list of influences on the possible success or failure of potential market for solar PV in the country.

Political: In spite of governments' intention to increase the use of renewable energy in electricity supply, particularly the use of solar PV for energy poverty reduction in rural and peri-urban areas of Africa There is political Influence on Grid Extension in Ghana. **Economic:** Under grid electrification, rural subscribers pay only about US\$1. 00 as connection fee and a subsidised lifeline tariff of about \$2. 00 /month for consumption below 50kWh.(4. 0cents /KWh). However the perception of the high cost of solar PV by the public (www. stoffstrom. org/.../2MEST) co No financial incentive exist except for the waiver of import duty on solar panels. the cost component of the duty exemptions makes very little impact on affordability of the systems. **Social:** As discussed above, solar panels constitute less than half of the cost of the entire system. An exemption of 10% duty will result in a 5% price reduction if the savings are passed directly to the consumer. Even at a monthly income of 2 million cedis (\$400 at mid-2000 exchange rates), a well-paid Ghanaian worker will have to devote five months' salary towards the purchase of a solar electric system for his home **Technological:** The main argument for local manufacture, other than technology transfer, is that lower labor costs will reduce overall costs (Carlson, D. 1993). In others, it has been argued that the introduction of manufacturing will reduce the cost of solar electric

systems and boost the industry (Mawuli Tse., 2000). Intermittent Nature of Renewable Energy and Storage Difficulties Many renewable energy sources are often dismissed because they cannot be stored and also because they are intermittent. Environmental: However, threats of global warming, acidification and nuclear accidents have made it possible to transform the existing global energy into a new focus, especially since the demand for energy is fast growing (Tester, Drake, Driscoll, Golay & Peter, 2005) RETs in general are considered more sustainable and environmentally benign than conventional energy systems that are based on fossil fuels (oil, gas, coal). Mawuli Tse.,(2000). Regulatory: According to applicable duty levies, solar panels are exempt from duties but still face a 12.5 percent VAT and fees of 3.5 percent. Solar system accessories on the other hand are not eligible for duty exemption. ghana In some cases the high taxes have been blamed, and policy measures have been taken to reduce the import duties on solar photovoltaics5 Mawuli Tse.,(2000).

3. 2Target Market

According to Kotter, P. and Armstrong G. (2011), target market is the process of evaluating the market segment's attractiveness and selecting one or more segment to enter. The target of the market is therefore rural communities that cannot access the national grid. Rural electrification is of crucial concern to the Government of Ghana ([http://www. slideshare. net/](http://www.slideshare.net/)). Solar PV electrification would contribute to improve quality of life in off-grid rural communities through the direct effect of the technology on household wellbeing and enterprise income (Obeng G. Y and Evers, H. D 2009)

3. 3 Market potential

Market is the set of all actual and potential buyers of product or service (Kotter, P. and Armstrong G. 2011). The Ministry of Mines and Energy in Ghana estimates that about 4, 000 communities do not have access to electricity (Mawuli Tse., 2000). These communities would however not electricity in the near future if is based on the national grid. In addition to the off-grid households, many institutions such as schools, hospitals, and government offices are located in offgrid areas which are not also connected to the national grid. Using 100 households as an average community size, it is further assumed that 5% of the households would be ready and willing to acquire domestic solar electric systems (Mawuli Tse., 2000). The table below is an indicative of the potential market of solar PV in rural communities in Ghana, the table shows that about 20, 000 households, 800 institutions, community base systems 800 and about 5, 000 other application is a potential market for solar PV in the country. Source: Mawuli Tse.,(2000).

3. 4 Sales Forecast

The target areas where Solar PV can contribute to sustainable development are places where the inhabitants could least afford the solar service. The cost of grid connected solar energy per kWh is over US\$0. 30 compared to US\$ 0. 04/kWh The cost of a solar panel facility in Ghana is about US\$ 7000/kW compared to US\$500-1000 for a gas fired thermal power plant (www. stoffstrom. org/.../2MEST) (Energy Commission, 2006). The volatility in the pricing of oil and gas on the international market increases the risk of the sales and investment of solar PV in the country. The sales of solar PV in

Ghana will therefore depend on the investors in the sector and the incentives provided by government.

2. 4 Market Opportunities

Renewable Energy Technologies, particularly PVs, can reduce the country's dependence on centralized power from hydro and fossil fuel sources. In times of domestic shortage, the cost of importing power from neighboring countries is even higher. These applications can easily be served by decentralized solar power. In addition to domestic use, many specialized applications such as water pumping and vaccine refrigeration exist. For example, there are over 200 hospitals and nearly 1, 000 clinics and health posts in the country. Many of them can be served with solar electricity more reliably than the grid, and at a lower long-term cost (Mawuli Tse., 2000). In Ghana, solar PV is making contributions to electricity access for household lighting, communication, water pumping, rural vaccine storage etc.

Telecommunication, Education, Health, Water supply, Security and there are still more than 48% of communities or 82% of rural households waiting to be connected to the grid ([www. zef. de/fileadmin](http://www.zef.de/fileadmin)).

3. 0 Market Requirements and Barriers to entry

3. 1 Barriers to the Development of solar market in Ghana

According to Loy (2007), reasons for the extraordinary low usage of solar energy and renewable energies in general are mainly the unfavorable political and legal conditions bringing up many barriers, for example monopolies of national utility companies and missing incentives for usage or sanctions for non-usage of renewable energies ([http://www. scribd](http://www.scribd)).

com/doc/92030784/Analysis). The first barrier identified is market failure/imperfection, Thus there is no available information and awareness, lack of access to technology, there is no competition and the cost transaction is very high, there is no infrastructure in terms of marketing, there are too many requirements when it comes to investment and the energy sector itself is under too much control by government (Gabienu S. Francis., 2011)Market distortions and under this barrier, issues like subsidies and taxes including trade barriers affect competition and the cost of solar PV may go up due to high taxes on imports. Economic and financial barriers: access to capital is difficult for producers to finance commercialization of PV in the country. Also the high cost of components, leading to high system cost affects the market. Furthermore, according to ISES, (2005) projects of solar PV often failed because of inconsistent government interventions, poor technology as well as missing planning and maintenance capacities.

3. 2 How to overcome the barriers

Liberalization of the energy sector: The main purpose of this liberalization is to introduce efficiency in the energy sector to introduce competition in the market., the environment of the energy market will be very healthy because of liberalization and a healthy growth among the renewable energy technologies will also be achieved (Norbert W, Painuly J, 1999)Guaranteed markets: Solar energy is part of the renewable energy technologies which are not able to compete well in the energy market due to the so many barriers that are preventing penetration and diffusion. This problem can only change if Ghana include solar PV energy into their supply mix (IEA, 1998)

4. 0 Conclusion and Recommendations

Having in mind the abundant solar radiation in the country, Ghana must necessarily and strategically rely on solar energy as a credible option to address the shortfall in energy delivery and access to vulnerable communities and the economically disadvantaged as a means to expand the use and application of solar energy which currently stands at an abysmal estimate of 0. 1%. (AGSI, 2011). Renewable Energy can be harnessed to support and supplement conventional energy supply. However, significant cost, technology and attitudinal barriers need to be surmounted before any meaningful penetration could be achieved.

Recommendations

To achieve the generating of solar PV in a large scale for rural consumption, government needs to provide incentives and financing schemes to stimulate the development of the sector. Since the income level of the rural communities is generally low. Government policy is designed to reduce CO2 emissions via solar deployment and to create high-tech jobs through the development of a strong national solar industry. Through a fee-for-service approach adopted in Ghana, project beneficiaries could overcome the barrier of high PV system costs and paid only fixed monthly service fees of GH¢1. 5 (US\$1. 63) for a 50Wp and GH¢2. 5 (US\$ 2. 72) for a 100Wp PV system (Amous et al, 2002; Obeng, 2008). Although there was little credit available for purchasing solar PV systems privately, the Government of Ghana took steps including fee-for-service approach to encourage the use of PV systems in off-grid rural areas (Institute of Economic Affairs, 1999) Without an effective evaluation of existing solar PV electrification projects, governments may not

be fully convinced of the benefits that can be derived from full scale implementation of solar PV projects to increase access to electricity to reduce energy poverty in off-grid rural and peri-urban areas. Obeng G. Y and Evers, H. D (2009) Finally In order to extend the coverage of solar PV electrification, political and policy measures including regulations, government funding and political commitment among others influence the project domain. Influencing the political and policy domain is the global environment within which external financing, international trade, partnership, development cooperation etc. take place.