PAPER

GHANA STRATEGIC PARTNERSHIP FOR EVIDENCE BASED ADVOCACY|SNV GHANA

Advocacy for increased investment in renewable energy-based mini-grids in island areas in Ghana

SNV

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List of abbreviations

AP	Advocacy Plan
CEESD	Centre for Energy, Environment and Sustainable Development
CSO	Civil Society Organisation
DGIS	Dutch Ministry of Foreign Affairs
EC	Energy Commission
ECG	Electricity Corporation of Ghana
GSGDA	Ghana Shared Growth Development Agenda (GSGDA)
KAP	Kwahu Afram Plains
MDG	Millennium Development Goal
MoP	Ministry of Power
NEDCO	Northern Electricity Company
NGO	Non-governmental Organisation
RE	Renewable Energy
SHS	Solar Home System
SNV	Netherlands Development Cooperation
TOC	Theory of Change
VRA	Volta River Authority
V4C	Voice for Change

Executive Summary

The Ghana Strategic Partnership for Evidence-Based Advocacy is a five-year project funded by the Dutch Ministry of Foreign Affairs (DGIS) and coordinated by Netherlands Development Organisation (SNV). The project christened "Voice 4 Change (V4C) Partnership" is aimed at empowering Civil Society Organisations (CSOs) to advocate for a conducive enabling environment in Water, Sanitation and Hygiene (WASH), Renewable Energy (RE), and Food and Nutrition Security. The project will build the capacity of CSOs to effectively voice alternative or dissenting views in a dynamic and increasingly global context, making them more powerful in lobbying and advocacy. It will equip CSOs to be able to collaborate with governmental actors, international and local parastatal bodies to effectively advocate for change in policies and implementation strategies that will positively affect the respective communities they serve.

Under this project, the Centre for Energy, Environment and Sustainable Development (CEESD), will advocate for the prioritisation of mini-grids in off-grid communities in Ghana and also push for the timely implementation of mini-grid plans as enshrined in government's policy statements. The focus of this advocacy is to influence key stakeholders to initiate actions that will result in the establishment of renewable energy based mini-grid electrification in island and lakeside communities in Ghana. This will result in increased access to affordable, efficient and sustainable energy solutions in target areas, allowing communities to enjoy collateral benefits that come along with availability of modern electricity including growth of businesses, improvement in education and health and general increase in quality of life. The realisation of the advocacy goal will further lead to the achievement of national development targets in a sustainable manner.

Ghana already has comparatively high access to electricity which currently stands at about 82% and hopes to achieve universal access by the year 2020. There exists also a very good rural electrification policy with substantial budgetary support which seeks to extend grid electricity to rural communities in Ghana. However, there are a number of off-grid communities where it is not economically feasible to extend the grid either due to the small population of the communities or the geographic location which makes it extremely difficult to extend the grid.

Renewable energy (RE)-based mini-grids are considered as viable alternatives for providing electricity needs for households and businesses in these remote island communities in situations where the national grid is not economical to extend. The government of Ghana is currently piloting five mini-grids in four island communities under its Medium Term Expenditure Framework. The pilot communities are Pediatorkope, Atigagorm, Aglakorpe, and Kudorkorpe.

As part of the V4CP program, CEESD conducted a baseline study in selected island communities to assess and confirm the energy needs of households and businesses; assess willingness and ability to pay for power from future mini-grids. The study also

explored the impact of operational mini-grid on the socio-economic conditions in selected communities currently enjoying mini-grid under the pilot program. The baseline study was conducted in island communities in the Kwahu Afram Plains North and South districts in the Eastern Region as well as Krachi East and West Districts in the Volta Region. Choice of the districts is in line with government policy direction of introducing off-grid solutions in these communities.

Five off-grid island communities without mini-grid were surveyed in four districts based on recommendation from district assembly officials. The communities are Sidikpoe and Kpadzekope, and Faaso Battor in the Kwahu Afram Plains (KAP) North district; Adidokope in KAP South district; Tumbugya-tekporkope in the Krachi East district; and Torkpor in the Krachi West district. The current sources of lighting in these communities are kerosene lantern, torch light (battery), solar lantern/lamp, candle, and generator. It was found that, apart from households using solar lanterns and solar home systems, households spend between GHS 5 to GHS 210 on buying kerosene, gasoline, or battery to produce electricity (light) every month. The amount spent depends largely on the household size which ranges between 1 and 28 people per household.

Also, two island communities with operational mini-grid electrification were surveyed with the aim of identifying the impact of the mini-grid on the people. Aglarkope in the Krachi West district and Kurdokope in the Krachi east district were surveyed. In each community, the assemblyman, chief/head of the community and randomly selected households were interviewed in addition to an official from the district assembly. The main occupation in the island communities is farming. Other forms of businesses that may require electricity include dress making, hair dressing, fish smoking and corn/cassava milling. Majority of the residents were satisfied with the operation of the mini-grid and the introduction of mini-grid has also seen the introduction of some new businesses including cold store for freezing fish/meat and selling of iced water.

As part of the survey, the district assembly executives and opinion leaders in the communities where informed about the V4CP program and how CEESD will collaborate with the communities to expedite extension of mini-grid to the communities.

Discussions were also held with policy makers. It was made known by the Ministry of Energy that the Ministry has targeted about 200 mini-grid projects by 2030 and that Government is seeking support to provide an efficient and cost-effective water transportation system to support mini-grid activities in island and lakeside communities. The discussions led to the conclusion that plans are underway to develop mini-grid infrastructure, however, the pace is slow owing to funding challenge. Thus, CEESD would have to develop specific advocacy strategies that will positively influence government to commit to fund mini-grid projects, in line with the National Electrification Policy.

1.1 Background

Many countries in sub-Saharan Africa are faced with a myriad of problems cutting across key economic sectors – agriculture, energy, sanitation, health and education. Ghana is no exception. The country is faced with several developmental challenges such as huge postharvest losses, ranging from 24 - 35% for some food crops[1], and over reliance on conventional cookstoves and "dirty" fuel sources that contributes greatly to indoor pollution, deforestation, acute respiratory related diseases and takes up a significant portion of household income in terms of money spent on fuels and time spent looking for firewood to prepare household meals[2]. Aside these, access to improved sanitation is no better; only 15 % of the population have access to improved sanitation.[3] This means Ghana failed to meet the MDG target of halving the percentage of those without access to improved sanitation.

Even though access to power in Ghana is comparatively high, currently at 80% and only second to South Africa in Sub-Saharan Africa, over 50% of rural households use other means apart from electricity as their main source of lighting.[4] Further, there are a number of off-grid communities where it is not economically feasible to extend the grid either due to the small population of the communities or the geographic location which makes it extremely difficult to extend the grid.

Many of these problems may not be due to the absence of requisite policy framework in place, as Ghana has some of the most exquisitely drafted policy documents in attempting to address some of these issues. For instance, the Ghana Poverty Reduction Strategy (GPRS) I and II, Ghana Shared Growth Development Agenda (GSGDA) I and II, the Sustainable Energy for All Action Plan are all major policy statement of the government which sought to address some of these challenges. It suffices to say that while in some cases tremendous progress was made, in most cases the progress was marginal. This may be due to the low effort on the part of Civil Society Organizations (CSO) to effectively partner government and other stakeholders to effect the desired change necessary to overcome the challenges.

1.2 Ghana Strategic Partnership for Evidence Based Advocacy

The Ghana Strategic Partnership for Evidence Based Advocacy is a five-year project funded by the Dutch Ministry of Foreign Affairs (DGIS) and coordinated by Netherlands Development Organisation (SNV). The project christened "Voice 4 Change (V4C) Partnership" is aimed at empowering Civil Society Organisations (CSOs) to advocate for a conducive enabling environment in Water, Sanitation and Hygiene (WASH), Renewable Energy (RE), and Food and Nutrition Security. The project will build the capacity of CSOs to effectively voice alternative or dissenting views in a dynamic and increasingly global context, making them more powerful in lobbying and advocacy. It will equip CSOs to be able to collaborate with governmental actors, international and local parastatal bodies to effectively advocate for change in policies and implementation strategies that will positively affect the respective communities they serve.

[1] CTA (2014), Analysis of postharvest knowledge systems in Ghana – a case study of Cassava *http://knowledge.cta.int/*.
[2] Ntiamoah A. and Afrane, G. (2012), Analysis of the life-cycle cost and environmental impact of cooking fuels in Ghana, Applied Energy, (98), 301 - 308
[3] WHO/UNICEF (2016), Joint Monitoring Assessment Program for Water Supply and Sanitation. http://data.worldbank.org/indicator/SH.STA.ACSN
[4] GSS (2014), Ghana Living Standards Survey (GLSS 6), Accra

Already, Non-Governmental Organisations (NGOs) and CSOs work with public and private bodies in Ghana in order to address developmental challenges. One major problem is a well-coordinated effort by these NGOs and CSOs through the fostering of collaboration with various actors on the policy landscape as well as international collaborators to effectively advocate for change in policy direction and implementation strategy.

The five-year project is being implemented in six countries, namely, Ghana, Kenya, Rwanda, Burkina Faso, Honduras and Indonesia.

1.3 CEESD work under V4C partnership

The Centre for Energy, Environment and Sustainable Development (CEESD) is a not for profit organization established in 2009 to address issues of climate change mitigation, environmental sustainability and the promotion of renewable energy through science and technology innovations in rural and peri-urban communities. CEESD has since its inception served several communities through the introduction of improved cookstoves, waste to energy technologies and clean power solutions to off-grid communities. Under the V4C Partnership, CEESD will seek to engage stakeholders including those mandated by the Ministry of Power (MoP), notably, Energy Commission (EC), Volta River Authority (VRA), and Electricity Company of Ghana (ECG), to develop and promote mini-grids in Ghana in a coordinated manner, as outlined in the Theory of Change (TOC) and Advocacy Plan (AP).

CEESD will advocate for the prioritisation of mini-grids in off-grid communities in the government's policy statements and to ensure its smooth and timely implementation. Proposed engagement strategies will explore short, medium- and long-term interventions with clear-cut actions and activities tailored to address the promotion, implementation, and acceptance of RE-based mini-grids in island communities.

1.4 Objectives and scope of study

The overall aim of this study is to inform target districts and island communities and other stakeholders of the V4C program on mini-grids and to build initial network of partners.

The objectives of the field work are therefore to:

- Brief some stakeholders on the V4C program on mini-grids and to incorporate their views in advocacy activities in 2017;
- Study the status of energy utilisation among households and businesses in island communities;
- Assess energy needs of residents and businesses in the communities without access to grid electricity; and
- Assess willingness of residents to pay for power from future mini-grids.

The baseline study was conducted in island communities in the Kwahu Afram Plains North and South districts in the Eastern Region as well as Krachi East and West Districts in the Volta Region. The districts chosen for the exercise are replete with many island communities and remote riverside villages without access to grid power. Choice of the

districts is in line with government policy direction of introducing off-grid solutions in these communities.

2. History, Status and Future of Mini-Grid Development in Ghana

2.1 Introduction

Renewable energy (RE)-based mini-grids are viable alternatives for providing electricity needs for households and businesses in remote island communities in situations where the national grid is not economical to extend. A mini-grid is defined as an electricity system that is technically separate and distinct from the main national electricity grid, sources power from its own generation unit and has two or more customers who are separate legally from the ownership of the system. Mini-grids can provide cost effective alternative solution for rural electrification if the volume of power consumed and the lower costs of electricity supply from the mini-grid infrastructure outweigh the high fixed capital cost of the connection to the grid.

Mini-grids are being considered in Ghana as a long-term alternative to grid connection for the minority of the population not yet connected to the national grid, similar to situations in other developing and developed countries. The main grid connections to some of these communities should not be ruled out. The choice however, between the connection to the main grid and the development of a mini-grid in a rural or isolated area depends on various economic, financial, social, environmental and technical parameters. Grid connection or extension remains the preferred method of electrification worldwide, mainly because of the economies of scale that curtail power supply costs. Recent technological and institutional innovation, combined with an overall cost reduction have made mini-grids an attractive alternative.

For Ghana to achieve universal access by 2020, there is the need to plan and implement mini-grids in remote communities where the national grid electrification programme will not reach. This section of the study therefore presents the extend of mini-grid development in Ghana and its prospects with respect to policy framework and technical considerations.

2.2 History of Mini-grid development in Ghana

Ghana is ranked among the countries with the highest national electrification rate in SSA. Notwithstanding, there are many remote and isolated areas, including island communities located within the Volta lake catchment, where grid power is yet to reach. The challenges of extending grid power to these communities include the lack of infrastructure (bridges, roads, etc.), high cost of laying underwater cables from the nearest grid facilities, willingness of the communities to accept and pay for mini grids, and RE resource availability. The government of Ghana, through the Ministry of Power, has recognised that the deployment of renewable energy (RE)-based mini-grids in island areas offers a long term and sustainable solution to the problem.

Mini-grids have a long history and were an integral part of the power sector development of many of the current high-income countries. They are only now emerging

as a scalable option for meeting the energy demand in Sub-Saharan Africa, South-East Asia and Small Island Developing States. In these areas, according to the International Energy Agency (IEA), mini-grids are a least-cost and timely option for more than 120,000 villages and towns.

In the past there has been unsuccessful mini-grid system for biogas and biofuels across the country. The maiden off grid system was the Appolonia Household Biogas Programme in 1986, which was to produce electricity from biogas in a community called Appollonia in the greater Accra Region[5]. The failure is attributed to the lack of technical expertise, maintenance problems, feedstock problems as well as lack of awareness creation. Aside this, a number of initiatives to provide off grid electricity for some communities across the country particularly in the northern part of Ghana using Jatropha Oil was also not sustainable.

In recent past, the Ghana Energy Development and Access Project (GEDAP), which began in 2007, included a component for Electricity Access and Renewable Energy to assist the Government in developing a commercially-oriented and sustainable framework for increasing access to electricity throughout the country. It complements the Government's efforts to achieve its electrification goals through intensification of unconnected customers in existing electrified areas, grid extension to new areas, and off-grid renewable energy options. Since the extension of the national grid to un-electrified remote and island communities will involve substantial up-front costs by the Government, one sub-component of GEDAP focused on providing electricity through the installation of stand-alone solar systems to these community dwellers. The project targeted remote communities that will not be served by the grid for at least 5-10 years; these communities were relatively low income. The overall goal of the project was to enable the rural dwellers to have access to electricity using solar PV systems

2.3 Current status and Prospects of Mini grid

Ghana has been remarkably successful in extending its national grid into the rural areas. According to the Ministry of Power, around 80% of communities with more than 500 people have access to grid electricity. The main remaining frontier is to bring electricity to communities living on islands in Lake Volta and in isolated lakeside locations. Some efforts to provide electricity to these communities through the use of mini-grids are ongoing. Under GEDAP,[6] mini-grids are being explored in pilot projects in four island communities. The challenge confronting Government regarding the implementation of these pilots and possible future mini-grids developed in the Lake Volta region is the uncertainty about the adoption of an appropriate business model(s) and application of the necessary policy and regulatory regime.

Aside this initiative, there has been several efforts on the parts of government and the private sector to develop the use of RE particularly, solar, biomass, hydro and wind for electricity production. From Government's Medium-Term Expenditure Framework

[5] Bensah E. C., Brew-Hammond A. (2009). Biogas technology in Ghana: a study of opportunities and constraints. Proceedings from Sunyani Polytechnic Lecture Series V, Sunyani, Ghana.

[6] http://www.worldbank.org/projects/P120016/addtional-financing-ghana-energydevelopmentaccess-project-gedap?lang=en&tab=overview

(MTEF) for 2014-2016, procurement processes are underway for the design, supply, installation, operation and management of mini-grids on 4 selected islands[7]. The communities include Pediatorkope, Atigagorm, Aglakorpe, and Kudorkorpe. The renewable energy sources considered included solar, hydro, wind, and biomass. The system is a solar PV with a backup diesel-based generator to provide electricity to the remote communities. Since the main goal of the project is to deploy a RE resource to meet a local need of electricity, the diesel-based generator is strictly used as a standby intermittently. The system is configured to produce 89% of electricity from solar PV and 11% from generator diesel-based sources for the communities, making the system almost renewable.

Most of the current mini-grids systems across the world are mainly based on RE. Owing to the availability of RE resources in Ghana, the prospects of mini-grids to provide electricity to remote rural communities remains very high. Nonetheless, policy framework and the necessary technical and human must be developed.

2.4 Existing Policy framework for the development of mini-grid in Ghana

Gaps in policies and regulations have been identified to be constraint in the acceleration of mini-grids in low income countries. Well-designed policies and appropriate institutional arrangements along with effective financing mechanisms can address many of these challenges and enable the successful and sustainable deployment of mini-grids.[8] Government policy plays a significant role in the development of the sector, from setting rules and standards to providing incentives and enforcing penalties. It is essential for the long-term sustainability of a mini-grid system to define clear roles and responsibilities for all entities including the community, government, and private developer in a policy, in terms of ownership, development and operation and maintenance.

In Figure 1, a framework for mini-grid policy is presented under three main categories: institutional structure and governance, technical standards and surveys and financial incentives and tariffs. Mini-grid policies can be assessed through the analysis of these elements as shown in Figure 2. These elements will help to ensure that mini-grid play a critical role in the long-term provision of electricity access.

[7] http://www.mofep.gov.gh/sites/default/files/pbb_/2014/Energy.pdf

[8] http://www.cleanenergyministerial.org/Portals/2/pdfs/Sustainable_Development_of_Renewable_Energy_Mini-grids_for_Energy_Access.pdf

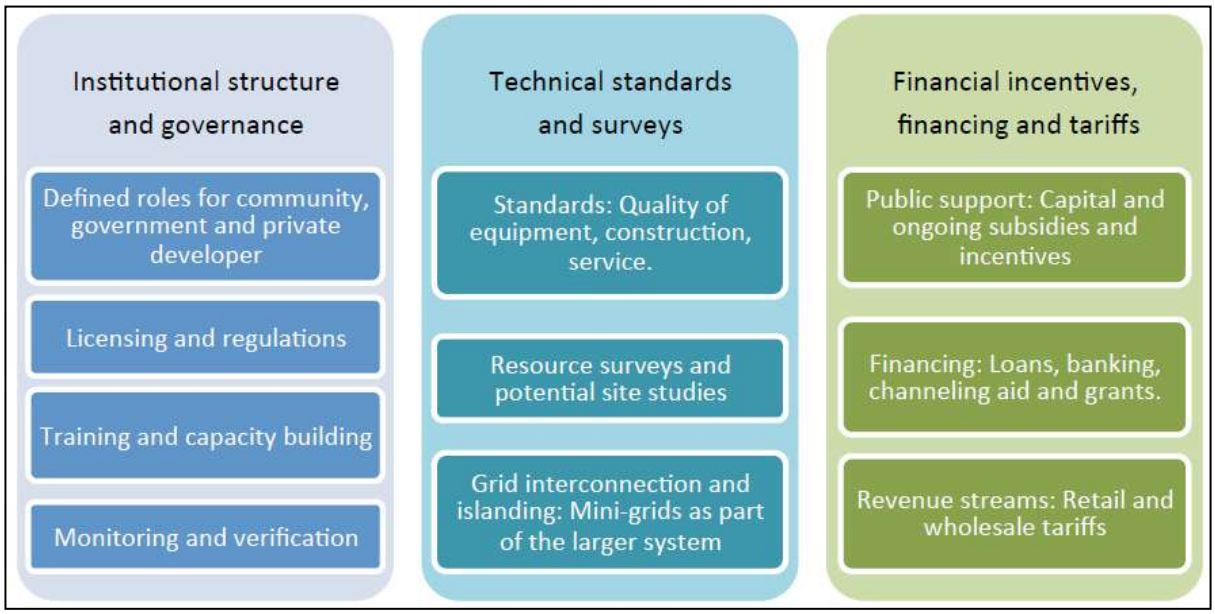

Figure 1 Categories of mini-grids Policy framework particularly for renewable energy[9]

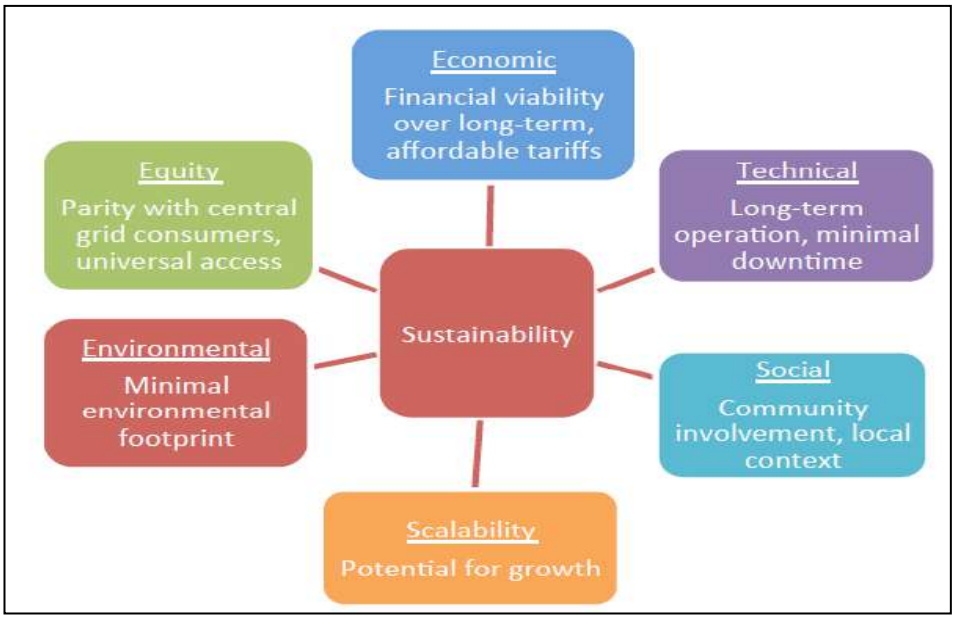

Figure 2: Elements of sustainability for assessing renewable energy based mini grid policies[10]

Ghana's efforts to attaining a high rate of electrification for the rural population is of importance. A number of national Policies therefore have been put in place to provide a sound environment for the development of mini-grid in Ghana. Even though there are no clear cut and specific policies for mini grids, a number of energy policies provides framework for the development of mini-grid in the country. Chief among such Policies and initiatives is the National Energy Policy and The Renewable Energy Act.

The electrification drive in Ghana has also taken place in the framework of a Universal National Tariff (UNT), thereby setting the precedent that all Ghanaians should not just have access to electricity, but that the price should be the same whether a household is in a remote rural area or is located in the capital city of Accra. This section describes the existing policy, legal and institutional framework in electricity/ renewables and identify gaps as they relate to mini-grids and how such policies fits into the general development of mini-grids in the country.

There is no specific mention of mini-grids in the current legislation except under section 32 of the RE Act where it is stated that mini-grids could receive support from the RE Fund.[11] Section 11 of the EC Act provides that, no person shall engage in any business or any commercial activity for, among others, distribution or sale of electricity without a licence. A similar provision is found in sub section (1) of section 8 of the RE Act. In the light of these provisions, the EC (licensing and technical standards regulator) and Public Utility Regulatory Commission (PURC), the economic regulator, were mandated to extend the existing traditional approach to mini-grid operations as a transitional arrangement pending the evolution of the rules for the development and operation of mini-grids. Regarding Feed in Tariffs (FiTs), section 25 of the Renewable Energy Act 2011, Act 832 gives the PURC the responsibility to set the FiT as the pricing mechanism for Renewable Energy Technology in Ghana.

2.5 Existing framework: Policy, Legislation, and Regulation

2.5.1 Electrification Policy

The 2010 Energy Policy notes a target to increase electricity access from the current level of 66% to universal access by 2020 by extending the reach of electricity infrastructure to all communities by 2020. To meet this objective, the policy notes (in Section 2.6) that the Government will pursue the following policy actions that are relevant to this assignment:

- Increase funding from Government and other multilateral and bilateral sources for the National Electrification Scheme;
- Support private sector co-financing with Government for grid-extension to designated franchised zones;
- Establish a sustainable internally generated funding mechanism for rural electrification;
- Support new service connections for electricity in rural areas;
- Address institutional and market constraints that hamper increasing electricity access to the poor; and

[11] The Parliament of the Republic of Ghana, 2011

- Promote productive uses of electricity as an integral part of the Rural Electrification Programme.

There is no specific mention of mini-grids in the policy statement, but it appears that there may give scope to consider mini-grids as one of the options for achieving universal access by 2020. This idea is reinforced by a statement from the World Bank's GEDAP PAD from 2007, which discusses the promotion of off-grid alternatives to grid-based electrification.

On the institutional side, the Government is planning to allow both grid-based electrification and off-grid alternatives to co-exist and complement each other. In addition, through innovative credit facilities, the Government wants to promote RE alternatives in areas that are outside the reach of the national grid. For example, one of the mechanisms of this new approach, in remote rural areas, will be to find ways of reducing the upfront cash cost of solar lighting equipment for consumers and improve the business environment for entrepreneurs to develop small solar energy businesses.

2.5.2 Uniform National Tariff

The objective of the National Energy Policy is to ensure that electricity pricing is efficient and competitive while providing rates that are affordable.[12] The Policy states the intent to pursue the following measures with respect to pricing and the setting of rates for electricity:

- Uniform electricity tariffs throughout the country;
- Support the implementation of cost recovery pricing in electricity supply;
- Provide special rates for the needy in society (lifeline tariffs);
- Regulate pricing of transmission and distribution services to achieve financial sustainability of the utility companies as well as ensure consumer protection.

Tariffs have traditionally been uniform since the advent of the grid some four decades ago. There is guidance of the policy from the PURC Act (Act 538), where Section 20 provides that the PURC may, having regard to the:

- population distribution of the country;
- need to make the best use of any natural resource of the country;
- economic development of the whole country, fix a uniform rate throughout the country, any region or district for any service provided by a public utility.

2.5.3 Renewable Energy

There is a requirement for distribution utilities and bulk customers to purchase a certain percentage of their power from renewable sources. This may help major utilities, but it is unlikely to help small diesel mini-grids.
The legislation would seem to place the renewable energy purchase obligation (REPO) on grid-connected entities. Consequently, a self-generator or standalone diesel plant would be exempt from the renewable energy purchase obligation. There had been discussions about the possibility of establishing a Rural Electrification Agency to oversee

[12] Ministry of Energy, 2010

aspects of rural electrification, in particular the non-profitable operations.[13]That idea seems to have been discarded and under the Renewable Energy Act, the establishment of a Renewable Energy Authority has rather being contemplated.

2.5.4 Permits and Licenses

There is no definition of the permits, licenses or concessions in the Ghana energy sector laws or in the Interpretations Act of Ghana. Permits and licenses in the Ghanaian context are distinguished by usage. For instance, the Energy Commission Act and the RE Act indicate the sector activities for which a license is required. Permitting is provided under third-tier guidelines issued by the EC, such as the siting permit requirements under the Commission's facilities Siting Guidelines, or the Bulk Customer Permit, which allows entities that consume a large quantity of electricity to shop for their supplier. Anyone engaging in a commercial activity in the electricity sector and the renewable energy industry must have a license (section 8 of the Renewable Energy Act). This also applies to companies selling Solar Home Systems (SHS). The licensing authority is the EC, which has developed a licensing manual for renewable energy technologies.

According to the licensing provisions, an applicant must be a Ghanaian citizen or a corporate body duly registered in Ghana. The application must be accompanied with information requirement that includes the technology and size of installation and the expertise available to the would-be licensee. Similar to the procedure in respect of all licences, the EC is obliged to grant the licence within 60 days of submission of a complete application and person dissatisfied with the decision of the EC may complain to the Minister who must render a decision within 30 days failing which the applicant may appeal to the courts. The licensing process is favoured by the governmental agencies and the EC in particular because it considers the information requirement essential for its national and indicative planning needs and also to ensure that basic siting and technical standards are adhered to at the inception phase.

Licensing is therefore:

- Considered a means of compelling the registered entity to share information—through a data submission process.
- To ensure the systems being established are robust and meet the technical standards and to possibly aid the post installation monitoring.

The EC is currently developing the framework for licensing mini-grid and there are as yet no specific licensing requirements. As a transitional measure and until the licensing process for mini-grids is established, EC proposes to licence mini-grid development as a RE Installation and Maintenance activity.

2.5.5 Concessions

With regards to concessions, the EC is authorized to delineate the zone or area to be covered by a distribution license and that grants the licensee the exclusivity rights to such zone or area. This will apply by extension to mini-grids. Under a concession, there is no requirement for government ownership of assets although traditionally the assets have been government owned. There is currently at least one investor owned distribution entity (Enclave Power Company) which procured and installed, owns and operates the network under license issued by the EC.

[13] http://sun-connectnews.org/file admin/DATEIEN/Dateien/New/E SMAPGhanaMinigrids_for_ last_Mile_Electrification_Optimized.pdf

2.5.6 Institutions

Ministry

The Ministry of Power (MoP) is responsible for formulating, monitoring and evaluating policies, programmes and projects in the energy sector. It is also the institution charged with the implementation of the National Electrification Scheme (NES), which seeks to extend the reach of electricity to all communities in the long term. Within the MoP, the Renewable Energy Directorate (RED) has been established to, amongst other things, oversee the development of the mini-grid programme until the establishment of the Renewable Energy Authority (REA).

Regulators

- **Energy Commission (EC):** Responsible for setting and regulating standards of technical operations and the issuance of licenses for operations. The Commission also advises the MoP on matters relating to energy planning and policy. The EC has prepared a Distribution Code. This is widely considered the technical standards, which will apply to grid connected RE technologies and mini-grid systems.

- **Public Utility Regulatory Commission (PURC):** Independent multi-sector economic regulator responsible for regulating tariffs of the Transmission and Distribution Utilities in the Power Sector (and also in the Water Sector). PURC will assess tariffs regarding the operations of mini-grids. The PURC Act requires the Commission to publish guidelines on the tariff approval process. The guidelines for mini-grids are yet to be developed.

Utilities

- **ECG:** The Electricity Company of Ghana is a limited liability Company wholly owned by the Government of Ghana and operating under the MoP. As noted previously, GoG is seeking to restructure ECG into a number of concessions.
- **NEDCo**: Northern Electricity Distribution Company (NEDCo) is an electricity distribution utility company in Ghana. The company is a subsidiary of the Volta River Authority, the main electricity generation company. NEDCo is responsible for supplying power to the three Northern Regions of Ghana, and part of the Brong Ahafo and Volta Regions, while ECG supplies power to the other regions.
- **Enclave Power**: Generates, purchases and distributes electricity power. It operates in Tema Free Zone.

2.6 Technical, environmental and social issues with mini-grid in Ghana

The reasons for failures of mini-grid systems has been reported to be lack of technical support from overseas installers, inadequate local capacity to train technicians and operators, inappropriate tariff structure and system complexity in terms of control and coordination of system components.[14] Technical, environment and social issues play a very significant role for the sustainable development and utilisation of mini-grid

systems. Even though mini grids have not been extensively developed in Ghana, critical technical and environmental issues must be analysed to ensure that any developed mini-grid system is technically efficient and environmentally sustainable.

The technical aspects of mini-grid policy design include the provision of resource surveys and grid extension plans that can facilitate planning for project developers, appropriate standards that ensure safety and reliability without being cumbersome, and facilitating grid interconnection and islanded operation of mini-grids (that are relatively large) to reduce uncertainty in the event of central grid extension. An important technical consideration for the development of mini-grids is surveying to determine the potential of the system in identified communities.

The provision of detailed surveys of resources at potential site locations and their ready availability to agencies and entrepreneurs can significantly reduce plans and community or potential consumers' details can prove important for scalability and rapid deployment of mini-grids. Experience shows that decentralized approaches like those of Tanzania, Cambodia and India usually rely on developers using informal means for obtaining resource location and availability of information. Knowledge of the context at the village or town level is usally necessary to have certainty of energy resource avaialbility. A number of such studies has been undertaken in Ghana, which have identified potential communities suitable for mini-grids.

Technical standards are important consideration for the sustainable development of mini-grids. Standards, if appropriately designed, can be effective and beneficial for all stakeholders. They can ensure long-term technical and environmental sustainability of the system. However, poorly formulated standards can be cumbersome and restrict innovation, especially when they specify design parameters rather than performance from the consumers' perspective. Technical standards reduce safety risks associated with low-quality equipment and construction. Technical
standards include those for generation equipment, distribution grid, and electricity service standards. Currently in Ghana, technical standards for the development of mini-grids are not yet available. This calls for relevant institutions and agencies to develop the necessary technical standards that will ensure the development of effective mini-grids across the country.

In the technical planning phase for mini-grids, an important consideration is what happens to the system if the electricity grid network is extended to the location. Depending on the policy and technical feasibility, mini-grids can be connected to the central grid where the local generator feeds electricity into the central grid. Further, the mini-grid could have the capability to isolate itself and continue to serve its customers in the event that the central grid fails (see Figure 3).[15]

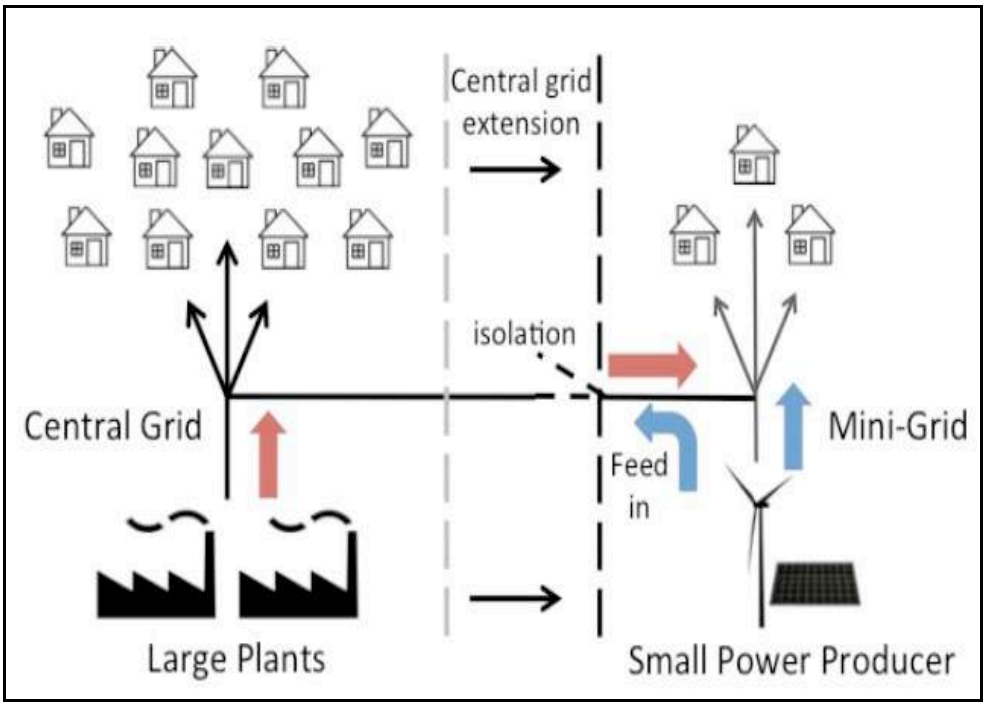

Figure 3: Grid interconnection and islanding of mini-grids

Current energy options available for un-electrified communities in Ghana indicates that provision of electricity access through mini-grids have the potential to contribute significantly to environmental management. The reduction of deforestation is one of the major environmental benefits of adopting renewable energy mini grid system. Since most current mini-grid systems are geared towards the use of renewable energy, negative environmental impacts of mini grids are minimal. However, Competition for land and with vegetation especially for solar photovoltaic (PV) systems and biofuels remains a concern.

Mini-grid system has the potential to provide several social benefits for the communities involved. Access to electricity can potentially result in many social benefits in areas such as education, healthcare, clean water and improved sanitation.

3. Overview and Outcome of Field Work

3.1 Results and discussion of field work

3.1.1 Communities with mini-grid

Two island communities with operational mini-grid electrification were surveyed with the aim of identifying the impact of the mini-grid on the people. Aglarkope in the Krachi West district and Kurdokope in the Krachi east district were surveyed. In each community, the assemblyman, chief/head of the community and randomly selected households were interviewed in addition to an official from the district assembly. The main occupation in the island communities is farming. Other forms of businesses that may require electricity include dress making, hair dressing, fish smoking and corn/cassava milling.

A. Operation of mini-grid in Kudorkope

Twenty-six people were surveyed in Kudorkope, the only island community with mini-grid in Krachi East, and one of the three mini-grids presently functional in Ghana. The average household size in this community is about 8.2 which is higher than the national average of 4.5[16]. All 26 people surveyed were using the mini-grid electricity in their home. No household was using other sources of electricity/light, which means they depend solely on the mini-grid for their lighting and power needs.

Figure 4 Solar module infrastructure at Kudorkope

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Figure 5 Solar battery bank at Kudorkope

The users pay between GHS 7.4 to GHS 70 per month for the power with an average monthly bill of GHS 18.1. When asked about whether they were happy with the operation of the mini-grid, 54 % of the respondents said they were happy with the system while 46 % said they were not happy and the major challenges with the mini-grid according to the end-users are shown in Figure 3.

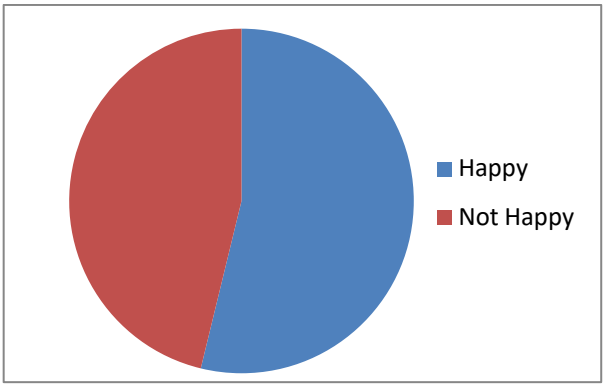

Figure 6 Operation and functioning of the mini-grid

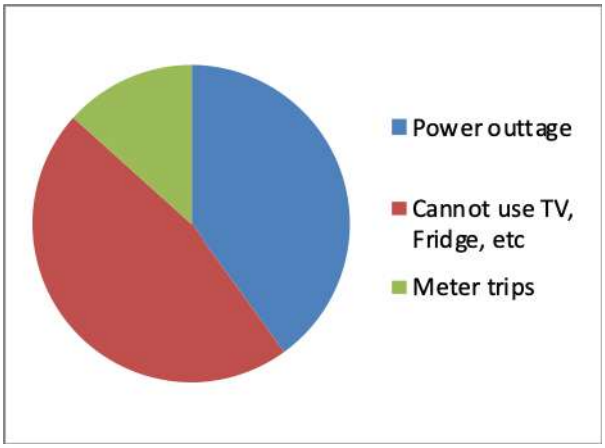

Figure 7 Challenges with use of mini-grid

However, the installation of mini-grid in the community has seen the introduction of some new businesses. This include, cold store for freezing fish/meat and selling of cold water.

B. Operation of mini-grid in Aglakorpe

Seventeen end-users were interviewed in this community. The two main occupations in the community are trading and farming. The community has an average household size of 10.2 which is more than twice the national average.

Figure 8 Mini-grid infrastructure at Aglakorpe

Figure 9 Solar module infrastructure at Aglakorpe

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All the households surveyed are connected to the mini-grid electricity. The households pay between GHS 7 to GHS 102 each month for the electricity with an average bill of about GHS 28. Everybody using the mini-grid was happy with its operation so far. It was found that about six new businesses have been introduced since the inception of the mini-grid. These include a beer bar (pub), a saloon, barbering shop, a video centre, and two provision shops.

3.1.2 Assessment of the need for mini-grid in island communities

The aim of this exercise was to inform stakeholders in potential communities for mini-grid electrification about the voice for change programme and also to assess the lighting needs and willingness to pay for power in these communities. Five off-grid island communities were surveyed in four districts based on recommendation from district assembly officials. The communities are Sidikpoe and Kpadzekope in the Kwahu Afram Plains (KAP) North district; Adidokope in KAP South district; Tumbugya-tekporkope in the Krachi East district; and Torkpor in the Krachi West district. Fasso Battor, a community in KAP North was also visited earlier. The current sources of lighting in these communities are kerosene lantern, torch light (battery), solar lantern/lamp, candle, and generator.

Apart from households using solar lanterns and solar home systems, households spend between GHS 5 to GHS 210 on buying kerosene, gasoline, or battery to produce electricity (light). The amount spent depends largely on the household size which ranges between 1 and 28 people per household.

Figure 10 A diesel-powered corn mill operation at Torkpor

All the respondents from the five communities surveyed wanted mini-grid electricity to replace their existing source of light. This according to them could help them do other things such as charging of mobile phones, watching television, listening to radio and/or using other appliances. They were willing to pay between GHS 5 to GHS 100 per month for the use of the mini-grid electricity.

Some other organisations working in these communities include PLAN Ghana, SEND, LINKS, Social and economic relief foundation (SERF), and USAID.

Figure 11 Meeting with inhabitants of Faaso Battor in Afram Plains North District

3.1.3 Outcome of discussion with Ministry of Power and Energy Commission

CEESD engaged two high-ranking personnel from the Ministry of Power and Energy Commission, namely, Seth Mahu, Deputy Director at the Renewable Energy Directorate of the Ministry, and Julius Nkansah, Technical Officer at the Renewable Energy Unit of the Commission. Both personnel lauded the idea behind the V4C program on mini-grids and offered valuable suggestions.

According to the Director, a national mini-grid policy has been developed and mainstreamed into the National Electrification Scheme, which could serve as a trump card to engage government to commit funds to mini-grid development in island areas under the V4C program. Under the policy, mini-grids would be public sector led investment with VRA taking responsibility of the generation sub-component and ECG/NEDCo responsible for the operation and management of the distribution sub-component within their respective operational areas. Customers on mini-grids would enjoy the same pricing policy as those on the main electricity grid under the rural electrification arrangement.

It was further made known that mini-grids are being planned for isolated villages and small rural towns, situated away from the national electricity grid and without realistic expectations for being connected in the near future. Moreover, the Ministry has targeted about 200 mini-grid projects by 2030 and that Government is seeking support to provide an efficient and cost-effective water transportation system to support mini-grid activities in island and lakeside communities.

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The personnel from the Commission also emphasized that plans are being put in place to develop mini-grids as part of the overall target of achieving universal electrification in Ghana. Thus, mini-grids will rely on a combination of resources found within beneficiary communities. These include solar, wind, biomass, hydro, and where necessary, diesel.

Discussions led to the conclusion that plans are underway to develop mini-grid infrastructure, however, the pace is slow owing to funding challenge. Thus, the CSO would have to develop specific advocacy strategies that will positively influence government to commit to fund mini-grid projects, in line with the National Electrification Policy.

4. CONCLUSION

The baseline study was conducted in island communities in the Kwahu Afram Plains North and South districts in the Eastern Region as well as Krachi East and West Districts in the Volta Region to assess the energy needs of households and businesses; to assess willingness and ability to pay for power from future mini-grids; to find out the impact of existing operational mini-grids on the socio-economic conditions of the communities and also to inform stakeholders as identified in our advocacy plan who could influence the development of mini-grid in Ghana about the Voice for Change Partnership.

Five off-grid island communities without mini-grid were surveyed in four districts based on recommendation from district assembly officials. The communities are Sidikpoe and Kpadzekope, and Faaso Battor in the Kwahu Afram Plains (KAP) North district; Adidokope in KAP South district; Tumbugya-tekporkope in the Krachi East district; and Torkpor in the Krachi West district. The current sources of lighting in these communities are kerosene lantern, torch light (battery), solar lantern/lamp, candle, and generator. It was found that, apart from households using solar lanterns and solar home systems, households spend between GHS 5 to GHS 210 on buying kerosene, gasoline, or battery to produce electricity (light) every month. The amount spent depends largely on the household size which ranges between 1 and 28 people per household.
Discussions held with policy makers revealed that Ghana government has targeted about 200 mini-grid projects by 2030. Already five pilot mini-grid projects are on-going and an interview with some beneficiaries in two of the communities show that majority of the residents were satisfied with the operation of the mini-grid and the introduction of mini-grid has also seen the introduction of some new businesses including cold store for freezing fish/meat and selling of iced water.

The discussions led to the conclusion that plans are underway to develop mini-grid infrastructure, however, the pace is slow owing to funding challenge. Thus CEESD would have to develop specific advocacy strategies that will positively influence

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government and development partners to commit to fund mini-grid projects, in line with the National Electrification Policy.

Appendix A: List of people interviewed

Name	Town	Contact	Gender
MR. AYITEY ANTHONY	TUMBUGYA TEKPORKORPE ISLAND	24652195	M
KOVE CECILIA	TUMBUGYA TEKPORKORPE ISLAND	543076800	F
AYITEY THOMAS	TUMBUGYA TEKPORKORPE ISLAND	547873218	M
JACOB ABOAKYE	TUMBUGYA TEKPORKORPE ISLAND	545298239	M
BRIGHT DZIKU	TUMBUGYA TEKPORKORPE ISLAND	543006963	M
DZIKU EMMANUEL	TUMBUGYA TEKPORKORPE ISLAND	541383803	M
ERNEST DZIKU	TUMBUGYA TEKPORKORPE ISLAND	244103548	M
FRANCIS DZIKU	TUMBUGYA TEKPORKORPE ISLAND	240670149	M
APEDEKE AUNTY	TUMBUGYA TEKPORKORPE ISLAND	245023159	F
GRACE SAKAH	TUMBUGYA TEKPORKORPE ISLAND	241698452	F
AYITEY ADDISON	TUMBUGYA TEKPORKORPE ISLAND	246975120	M
ATIVOR EBENEZER	TUMBUGYA TEKPORKORPE ISLAND	241834566	M

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VIFA JAMES	TUMBUGYA TEKPORKORPE ISLAND	241180599	M
AYITEY BESAH	TUMBUGYA TEKPORKORPE ISLAND	240231183	M
AWUDI MAUGI	TUMBUGYA TEKPORKORPE ISLAND	240231183	F
AZIEBU KWADWO	TUMBUGYA TEKPORKORPE ISLAND	241582233	M
SOLOMON AYITEY	TUMBUGYA TEKPORKORPE ISLAND	246937119	M
JOHN ASIWOME LODE	TUMBUGYA TEKPORKORPE ISLAND	246482877	M
AWUKU KOVE	TUMBUGYA TEKPORKORPE ISLAND	242338387	M
AYITEY PATRICK	TUMBUGYA TEKPORKORPE ISLAND	240193126	M
ERNEST DZIKU	TUMBUGYA TEKPORKORPE ISLAND	244103548	M
FRANCIS ALOSI	TUMBUGYA TEKPORKORPE ISLAND	246482877	M
CHARLES DJAMGMAH	KUDORKOPE	241992269	M
ABLEBLE NORTEY	KUDORKOPE	543265650	M
GODFRED NAKUTEY	KUDORKOPE	549110327	M
KWASI DJANGMUE	KUDORKOPE	240999766	M
MARY NORTEY	KUDORKOPE	548226693	F
NUATEY SAMUEL	KUDORKOPE	545465402	M
AKWATE MARY	KUDORKOPE	O544270501	F
JANET ABOAH	KUDORKOPE	O248094709	F
JANET AKWETEY	KUDORKOPE	O249073101	F

KWEKIE DJANGMAH	KORDUKOPE	O245056060	F
MOSES ABLEBLE	KUDORKUPE	246362119	M
NOAH OBISEI	KUDORKUPE	O247548996	M
REGINA OYADEYE	KORDUKOPE	O546818733	F
ABOAH ELIA	KUDORKOPE ISLAND	O249694168	M
ABOA EMMANUELL	KUDORKOPE	O557913755	M
ABOA JOHN	KUDORKOPE	244238619	M
AKWATE MARY	KUDORKOPE	O544270501	F
DOCI SOTTI	KUDORKOPE		F
EVANS DJANGMA	KUDORKOPE	O547491085	M
GODFRED NAKUTEY	KUDORKOPE	O549110327	M
KWAKU K.K	KORDUKOPE		M
KWASI DJANJMUE	KUDORKOPE	O240999766	M
MABEL AKWELE	KUDORKOPE		F
MARTHA ANOR	KORDUKOPE	0241704168	F
NOAH OBISEI	KUDORKOPE	0247548996	M
VICTORIA ABLEBLE	KORDUKOPE		F
SOTTIU ISAI ASTU	KRACHI EAST,KUDORKOPE	0540713776	M
YAKUBU MOHAMMED HARDI	KRACHI EAST DISTRICT	0242151588	M
MR. AWUKU TEKPOR AYITEY	KRACHI EAST/TUMBUGYA ISLAND	0504286665	M
Nantey Aborlorse	Torkpor-Newtown	242131704	M
Daniel Atiapa	Torkpor-Newtown	543198008	M

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Moses Anyabor	Torkpor-Newtown	543736443	M
Kwabena Asankuma	Torkpor-Newtown	547435657	M
Victoria Dzamesi	Torkpor-Newtown	248687207	F
Isaac Anyarbor	Torkpor-Newtown	244476673	M
Amewuga Mudo	Torkpor-Newtown	245221966	M
Mawuli Agbekra	Torkpor-Newtown	548177095	M
Francis Tetteh Annorborh	Torkpor-Newtown	247133856	M
Gli Daniel	Torkpor-Newtown	54157886	M
Bortwa Ga Stephen	Torkpor-Newtown	504157886	M
Tokoli Obourba	Torkpor-Newtown	549206978	M
Patrick Muodo	Torkpor-Newtown	542520255	M
Faustina Akortiago	Torkpor-Newtown	540929287	F
Gideon Tetteh Akral	Torkpor-Newtown	241982226	M
Kafui Koney	Torkpor-Newtown	547413963	F
William Akli	Torkpor-Newtown	241681059	M
Jonathan Omeri	Torkpor-Newtown	246199041	M
Emmanuella Aonotey	Torkpor-Newtown	547562609	F
Dakei Sampson	Torkpor-Newtown	547231969	M
Jacob Jaryee	Torkpor-Newtown	244552260	M
Grace Kwame	Torkpor-Newtown	540431808	F
Abraham Aternyo	Torkpor-Newtown	246146323	M
George Atseyo	Torkpor-Newtown	545175159	M
Moses Pinto	Torkpor-Newtown	241683815	M
Alimo Kofi	Torkpor-Newtown	249432480	M
David Pinto	Torkpor-Newtown	543736178	M
Charlot Oyeadea	Torkpor-Newtown	242008881	M
David Kuago	Torkpor-Newtown	545788352	M

John Kuago	Torkpor-Newtown	544670655	M
Michael Adzisiwa	Torkpor-Newtown	247887146	M
Alfred Awatorvi	Torkpor-Newtown	246952588	M
George Ayekuma	Torkpor-Newtown	247332964	M
Dzudevi Yebovi	Torkpor	548437627	M
Rafeal Patu	Torkpor	249344077	M
Eld Peter Agama	Torkpor	241669211	M
Alex Opoku	Torkpor	547421003	M
C.K Gbadago	Opposite the football field	554711905	F
Seth Eglah	Behind zigbuitor's house		M
Kwadjow Delafeme	Near zigbuitor's house		M
Azieku Amenornu	Adjacent Mr.Agbesi's house	206525638	M
Agbesi Anawusu	Near the Christthe Founder's Chapel		M
Joshua Dablu	Near football field		M
Agbey Glah	Near the fooball field		M
Agbesi Anawusu	beside zigbuitor's house		1
Agbey Amenornu	Behind zigbuitor's house		M
Emmanuel Ekahlor	Behind Chrisst is the Founder church	504915420	M
Agbeko Edze	Opposite the football field	201540117	M
Benard Amekumenya	Near the football field		M
Yaw Amekumenya	Behind the football field		M

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Mr.Mensah Xedidor (Onyinoe)	Opposite the football field	202722151	M
Tordia Xedidor	Opposite the football field	241412212	M
Mr.John Kalala Akatti	Opposite the football field	205637012	M
Worfa Amenorwu	opposite Agbesi's house		M
Abisibey Kulego	Beside manasea's house	200942886	M
Godwin Kulego	Adjacent Abisibey'shouse		M
Hanah Akpoeteeh	Near Divine Chapel	557901576	F
Patu Simon	Near chief palace	549185522	M
Mary Saki	Near Tawiah saki's house		F
Ekutey Akorlor	Near Akate house		M
Tawia Saki	Behind the chief palace	248115633	M
Torgbe Kpadzi 11	Chief palace	249917544	M
Samuel Konsi Agbesi	Near chief palace/	208621890	M
Quarnsah Quaye	Quannsah's house/Kpadzekope		M
Abraham Asilevi Kwame	Adjacent Tawiah's house	542076589	M
Zilevu Edegbe	Besides Sidikope's road	247918476	M
Akuffo Okutu	Behind Agbesi's house		M
Anyenu Odai	Behind Aslevi's house	241389222	M
Ametey Dze	Near Abeko house		M
Vudugah Morgan	Chief palace	206232420	M
Mark Dzramdo Vuduka	Back of Chief house		M
Richard Vudugah	Near he chief palace		M
Nartey Odae	Near he football field	554497444	M
Joseph Ajawutor	Near Believers Living Church	0556930845/0201736939	M

Nanor David	Behind Belivers Living Church	240191677	M
Josua Oman	Near Abisibary	240838401	M
Mishel Tete	Near Nana house	249271867	M
Christian Losu	Near chief palace	577018068	M
Addo Odae	Near Divine Chapel		M
Moses Fosu	Near chief palace	573620912	M
Prosper Losu	Near chief palace	546962320	M
Nartey Sackey	Near Divine Chapel	249071279	M
Tetteh Odai	Near Odifo Nkansah Church	542897968	M
Dodzi Vudugah	Near the football field		M
Lottey Agbeble	Behind Ebenezer English Church		M
Monica Titi	Penticost church	508938780	M
Happy Bgadebga	Johnson Adigra's house	541064355	F
Bertha Edra	Akyma maame house	507440933	F
Obed Mlagadah	Yegbekope assembly area	245410309	M
Sam Akrobeto	Chief palace		M
Setordzi Asigbe	Asigbe's house	248816686	M
Ben Azilaka	Near the football field	543217748	M
Francis Siamutey	Siamutey's house		M
Gameli Togbe Ahortor	Gama's house	555786526	M
Vicky Mkpenu	Kowunane Edra house		F
Gashiko Abiowu	Gashiko house		F
John Amuzu	aavon house	541603181	M

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Janet Baako	Janet Baako house	246820036	F
Otuasidika	Oten's house	249419191	M
Jennifer Tefutor	Nafisa's house	249844142	F
Laweh Asideka	Otukokye house	249040040	M
Naomi Asiedeka	Near Afawobo house	540515009	F
Emmanual Acaposu	Near the chief palace	543401388	M
Emmanuel Afarigyan Adigrah	Near Adidokope Primary school	246585948	M
Tetteh Siada Joe	Near the football field	544685961	M
Tetteh Asidoca	Near school park	541114671	M
Isaac Gorga	Near maranatha church	554046886	M
Gakyeko Agbewu	Near the football field	246160845	M
Mustapha Akpelita	Near the football field	548750221	M
Hwunae Drah	Adidokpo Hwunae Drah fie	247519758	M
Mr.Robert Agbasa	Maranatha prayer mission premise	243441665	M
Comfort Gahinor	Near the football field	543510432	F
Jonas Kwudigidigla	Near the football field	240244472	M
Solomon Dogviavo	Near the football field	240977098	M

Appendix B – Sample Questionnaire for communities without mini-grid

CEESD Mini-Grid Electrification Advocacy Project SNV

Baseline information from Opinion Leader in selected communities (Assemblymen, Chiefs, Headmen, etc)

A. Interviewer profile

Name	
E-Mail:	
Phone number:	
Date of interview	
Interview no.	

B. General information

S/N	QUESTION	RESPONSE
1.	Name of contact person(s)	
2.	Position/Responsibility	
3.	District	
4.	Phone number	
5.	Gender	

C. Information on community

S/N	QUESTION	RESPONSE
6	Name of Island Community/Village	
6	Number of settlements within the village	
7	Population of community/village	
	Number of businesses in the village	
12	Type of business in the island communities	[1] Retailer/kiosk/provision shop [2] Seamstress [3] Hairdresser [4] Corn mill [5] Video center [6] Barber/saloon [7] Restaurant/chop bar [8] Beer bar (pub) [9] Others (Please specify)
8	Are there any mini-grid electrification projects in the island	[1] Yes [2] No
13	Current source of lighting (Choose as many as applicable) in the island	[1] Kerosene lantern [2] Generator set [3] Solar lamp/lantern

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	communities	[4] Solar PV (panels with inverter)
		[5] Mini-grid electrification
		[3] Torch [Dry cell powered]
		[4] Candle
		[5] None (No light)
		[6] Others

Appendix C – Sample Questionnaire for communities with mini-grid

CEESD Mini-Grid Electrification Advocacy Project SNV

Baseline on operation of mini-grids for rural electrification – End-users

(Aglakope in Krachi West District, and Kudorkope in Krachi East District, Volta Region)

A. Interviewer profile

Name	
E-Mail:	
Phone number:	
Date of interview	
Interview no.	

B. General information

S/N	QUESTION	RESPONSE
1.	Name of respondent	
2.	Location:(notable landmark)	
3.	Phone number	
4	Gender	
5.	Level of education	[1] No formal Education [2] Primary [3] JHS [4] SHS/Technical/Vocational [5] Diploma/University
6.	Occupation	[1] Unemployed [2] Trader [3] Farmer [4] Formal Employment (e.g Teacher, nurse, banker, etc) [5] Skilled worker (e.g. carpenter, mason, driver, etc) [6] Others (please specify)
7.	Household size (number of people in your family)	
8.	GPS coordinates	

C. Information on lighting

S/N	QUESTION	RESPONSE
9	Do you use the mini-grid electricity?	[1] Yes [2] No
10	If No, Why	[1] Too expensive to get connected [2] I can't pay the bill [3] I do not want it [4] I was not connected even though i wanted it

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		[5] others
11	If YES, why much do you pay monthly	
12	Other sources of lighting (Choose as many as applicable) in your house	[1] Kerosene lantern [2] Generator set [3] Solar lamp/lantern [4] Solar PV (panels with inverter) [5] Torch [Dry cell powered] [6] Candle [7] None (No light) [8] Others
13	Are you happy with the operation of the mini-grid	[1] Yes [2] No
14	What challenges do you face with the mini-grid	[1] High electricity bill [2] Light out (Power outages) [3] Others
15	Has there been an increase in economic activities in the community because of the mini-grid?	[1] Yes [2] No
16	If, YES, how many new businesses have been established since the operation of the mini-grid	
17	Type of businesses in the community (island)	[1] Retailer/kiosk/provision shop [2] Seamstress [3] Hairdresser [4] Corn mill [5] Video center [6] Barber/saloon [7] Restaurant/chop bar [8] Beer bar (pub) [9] Others (Please specify)

Bibliography

- Bensah E. C., Brew-Hammond A. (2009). Biogas technology in Ghana: a study of opportunities and constraints. Proceedings from Sunyani Polytechnic Lecture Series V, Sunyani, Ghana.
- CTA (2014), Analysis of postharvest knowledge systems in Ghana – a case study of Cassava *http://knowledge.cta.int/*.
- Deshmukh, R., Carvallo, J. P. and Gambhir, A. (2013). Sustainable Development of Renewable Energy Mini-grids for Energy Access: A Framework for Policy Design. Accessed on 9th December 2016. Available online: http://www.cleanenergyministerial.org/Portals/2/pdfs/SustainableDevelopment_of_Renewable_Energy_Mini-grids_for_Energy_Access.pdf
- Dutt, B. K. and MacGill, I. (2013). Addressing some issues relating to hybrid mini grid failures in Fiji. Accessed on 9th December 2016 (available online: http://ceem.unsw.edu.au/sites /default/files/doc umnts/06629898.pdf
- Lasseter, R.H and Paigi, P (2004). "Microgrid: a conceptual solution," pp. 4285–4290.
- Ministry of Energy Ghana (2010). National Energy Policy, Accessed on 10th January, 2016. Available from internet- http://www.mofep.gov.gh/sites/default/files/pbb/ENER GY%20 PO LICY-% 2 0Febru ary %2013,%202010%20FINAL.pdf
- Ntiamoah A. and Afrane, G. (2012), Analysis of the life-cycle cost and environmental impact of cooking fuels in Ghana, Applied Energy, (98), 301 - 308
- The Parliament of the Republic of Ghana (2011). The Renewable Energy Act 832. Accessed on 15th January, 2016, Available from the internet-
- http://energycom.gov.gh/files/RENEWABLE%20ENERGY%20ACT%202011%20(A CT%20832).pdf
- WHO/UNICEF (2016), Joint Monitoring Assessment Program for Water Supply and Sanitation. http://data.worldbank.org/indicator/SH.STA.ACSN
- http://www.worldbank.org/projects/P120016/addtional-financing-ghana-energydevelopmentaccess-project-gedap?lang=en&tab=overview
- http://www.mofep.gov.gh/sites/default/files/pbb_/2014/Energy.pdf
- http://www.cleanenergyministerial.org/Portals/2/pdfs/Sustainable_Development_of_Renewable_Energy_Mini-grids_for_Energy_Access.pdf
- http://sun-connectnews.org/file admin/DATEIEN/Dateien/New/ESMAPGhanaMinigrids_for_last_Mile_Electrification_Optimized.pdf

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