KWAME NKRUMAH UNIVERSITY OF SCIENCE AND TECHNOLOGY, KUMASI.

COLLEGE OF ENGINEERING

DEPARTMENT OF MECHANICAL ENGINEERING

CENG 291

AN ALTERNATIVE MEANS OF POWER DURING POWER CUT IN HALF ASSINI

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DEDICATION

I dedicate this work first to the Almighty God for the gift of life and also for making all this possible. Second, I thank my parents for the support they gave me during this project. And lastly, to all my colleagues who assisted me as well.

ACKNOWLEDGMENT

I would like to express my appreciation to the staff of the Department of mechanical engineering, Kwame Nkrumah University of Science and Technology (KNUST) for their help with this project. Specifically, I would like to give thanks to my supervisor in this course for his guidance before the whole project. Also a big thanks to Mr. Kennedy Addison who has been a mentor to me.

I finally thank the Half Assini township for their time and contributions during the process. I appreciate all your comments received and have made very use of them all.

ABSTRACT

The frequent power outages in Half Assini have been a major problem in my community for ages which cannot be looked upon. As a result of this many have looked for a remedy to it which has been to no avail. This power outage has really caused us a lot of problems and needs to be addressed. This report seeks to outline the causes, effects, and possible solutions to help deal with this situation at hand.

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CHAPTER ONE

INTRODUCTION

Fig. 1.1

Photo of students learning with lanterns during a power outage

CENG BACKGROUND

Engineering is the creative application of science, mathematical methods, and empirical evidence to the innovation, design, construction, operation, and maintenance of structures, machines, materials, devices, systems, processes, and organizations (Wikipedia).

Engineering in society (CENG 291) is a new course introduced in the curriculum of the college of engineering in KNUST. The course is geared at inculcating the attitude of problem-solving among students of the college in their respective fields of study. The course also tends to encourage students to appreciate their course of study and broadens the scope of students in their chosen field. The course also tends to create a link between the chosen field of study of the students and solving societal problems using the said field. The objectives of this assignment are to identify a developmental challenge in a selected community and indicate how my chosen field of engineering (in this case computer engineering) can address the challenge.

LIST OF TABLES AND FIGURES

METHODOLOGY

Problem Identification

After several observations for about a week throughout Half Assini, I noticed that the frequent power outage in my community is doing us more harm than good, as this situation has led to the destruction of many properties of the inhabitants and also affected many students in the community as they are not able to study without electricity in the community.

Data collection

To better understand the problem to be solved and gain more knowledge to be able to develop the best solution, these methods are used in data collection:

1. Observation
2. Survey conducted by giving out questioner.
3. The use of the internet for extra information
4. The problem was captured by taking pictures to show evidence of the problem at hand.

Preparation of Maps

I completed the Google LLC source project through Google Maps to support the Half Assini map.

Community under stud

Fig

1.2

fig.1.3

Half Assini, also known as Awiane, is a small town and is the capital of Jomoro Municipality, a Municipality in the Western Region of Ghana.
Half Assini (Half Assini) is a populated location (class P - Populated Place) in Ghana's Western Region with the continent/middle east font code. It has a population of 43,403 and is situated at an elevation of 70 meters above sea level. It serves as the district capital of the western region's Jomoro district. It shares junctions leading to two main border towns. It holds the main government offices in the district.

Its coordinates are 5°3'0" N and 2°52'60" W in DMS (Degrees Minutes Seconds) or 5.05 and -2.88333 (in decimal degrees). Its UTM position is WL15 and its Joint Operation Graphics reference is NB30-11.

Problem statement.

It's simple to take things for granted in today's world. Additionally, one of the things that is most simple to take for granted is the unseen force that runs almost everything in your house: electricity.
It's simple to overlook electricity because it has become such a crucial component of daily life—until it stops working. A power outage, also known as an abrupt loss of electricity, can have an adverse effect on all activities, including working, cooking, and being able to see at night.
In most populous places, the global energy power infrastructure is strong and built to endure both natural disasters and human faults that might potentially bring the system to a halt. While most of the time this works, occasionally the system malfunctions and the power goes out.

fig.1.4 **photo of a power outage at half Assini**

Objectives

Below are the goals of the study undertaken

1. To seize the frequent power outage in my community.
2. To help control air pollution since it does not evolve any pollutant into the atmosphere.
3. To help save money as well.

Power outages

When the electrical power network, often known as the electrical grid, is down, there are power outages. Power outages can have a variety of causes, but they always tend to affect entire regions or cities rather than simply a single residence.

Why? because the electrical company, not the house, is to blame for the outage. When a home loses electricity but the rest of the neighborhood has power, a circuit breaker malfunction or some other domestic issue is probably to blame.

Fig.1.5

Causes of power outages

Power outages can have a variety of causes. The three most frequent causes, though, are overload, human error, and natural causes. Basically, any disruption between the production of electricity and its delivery to houses might result in a power outage. It can be caused by bad weather, human error, defective equipment, and even animal involvement. Power outages can also result from scheduled maintenance, however, this is typically disclosed to families in advance by the utility company.

How Long Do Power Outages Last?

The majority of power outages are brief, often ending seconds or minutes after they started. But occasionally, disruptions might persis for t a long time, even a few weeks.

Electricity lines may be destroyed and create significant delays when power is restored since some power outages are brought on by lightning or strong winds. When a substantial portion of the population lacks power for an extended period of time, entire communities are affected, as well as the economy. For example, last year 2021 the half Assini township experienced a total power outage for about a month which led to the destruction of a lot of properties. This situation even brought about the name '**dumsor'** which means the electricity has gone off.

Types of power outages

Blackouts, brownouts, permanent faults, and rolling blackouts are the four basic categories of power outages. These are all treated differently and have various causes, which are detailed below.

Blackout: A place experiences a blackout when all power is lost. Power outages of this kind generally affect a sizable population over perhaps extraordinarily broad areas. Blackouts are particularly difficult to quickly fix because they typically result from significant damage to electrical generation facilities (such as structural damage from violent wind storms or lightning strikes). As a result, these types of outages can, in the worst-case scenarios, last for several weeks.

Brownout: When electrical voltage or the overall availability of electrical power is reduced, brownouts frequently happen. When the voltage drops, lights dim, as the name implies. Even though there isn't a total loss of power during a brownout, equipment performance can suffer, and some appliances, like hair dryers and electric ovens, might not work at the lower voltage.

Permanent Fault: These kinds of power outages are a result of a permanent fault, which is an abrupt loss of electricity that is often brought on by a power line issue. These are straightforward and simple to handle because power is automatically restored after the fault has been fixed. Due of the fact that this kind of outage frequently trips lines further down the supply line to residences, it rarely affects huge areas. This is caused by issues with the supply mechanism, which are typically straightforward to identify and resolve, as opposed to greater blackouts and brownouts, which are caused by issues with the generation.

Rolling Blackouts: As scheduled power disruptions, rolling blackouts are very distinct from the other three. These are typically used in places where the grid is unstable or where the infrastructure cannot support the population. If there is insufficient fuel to run power at maximum capacity, whether for a short or extended period of time, rolling blackouts may also result.

Consequences of power outages
As a result, both producers and consumers suffer sizable financial losses as a result of the power outage. Due to operations being hampered when they happen, power outages can disrupt daily domestic activities as well as the economy. By delaying tasks that need electricity, they can lower work productivity. A summary of the consequences of a power outage in the neighborhood is provided below.

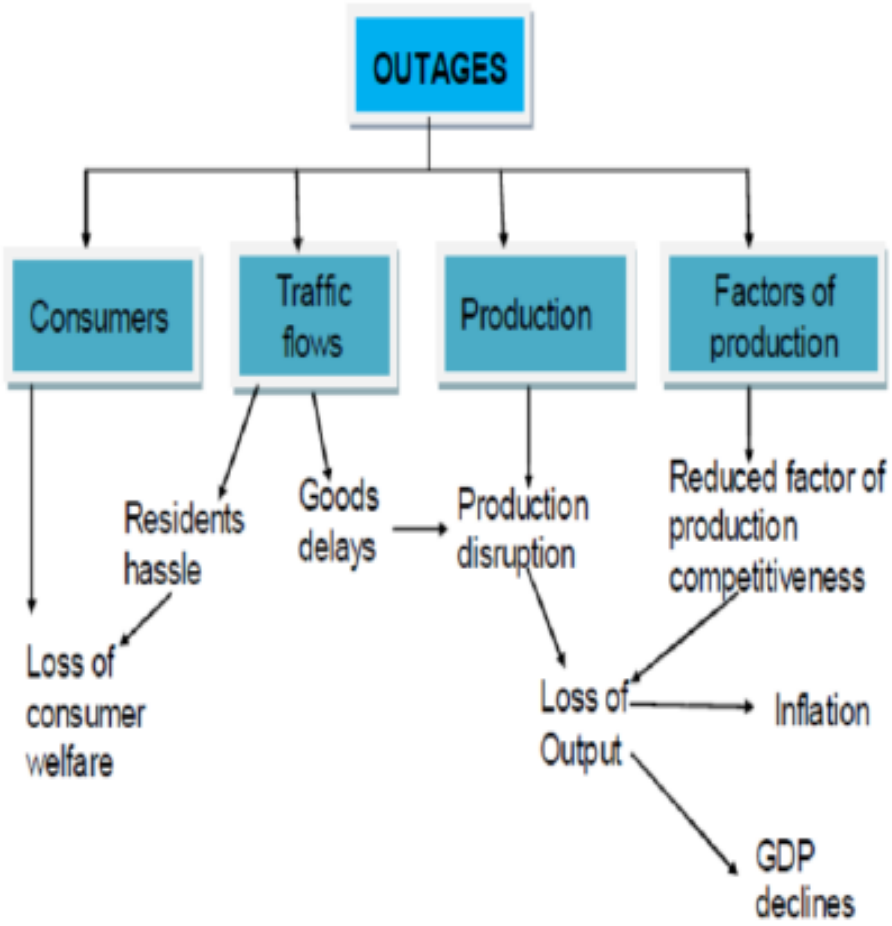

Fig 1.6

CHAPTER 2

DESIGN PROCEDURE

DESIGN BRIEF
To manufacture a solar panel to set as an alternative form of power to help solve the problem of power outages in Half Assini.

DESIGN
An alternative power source to deal with the power outages in Half Assini.

METHODS AND PROCESSES
The techniques and methods used have been evaluated with the aid of Product Design Specification (PDS)

PRODUCT DESIGN SPECIFICATION (PDS)

After a thorough lookup was once conducted, the following product design specifications had been viewed in tackling the trouble at hand.

- **Materials**: Depending on the material's optical and thermal properties as well as fabrication possibilities the material can decide large parts of the cells' final efficiency and cost. The materials used for the panels need to absorb most of the light in the solar spectrum, to maximize the energy input. Reflection, the bouncing of light, against the cells should be made as small as possible.

- **Manufacturing:** Manufacturing is of course an important part of the product development process, which is why it needs to be carefully considered in the pre-assembly stage. Materials needed in order to manufacture solar cells are easily obtained at the market for production.

- **Life in service**: Solar panels are very durable and usually trap sunlight using their photovoltaic cells during the day.

- **Environmental impacts:** With regards to solar panels it does not cause any environmental pollution and also minimize the use of electric generators which causes air pollution.

- **Costs:** Since solar panel is a renewable source of energy, it reduces costs that could have been spent on fuels.

CONCEPTS DEVELOPED AND EVALUATION

CONCEPTUAL IDEAS AND DESIGNS

So with regard to solving the problem of power outages in Half Assini. I came about with these conceptual designs which would help solve the problem at hand to be carefully studied and evaluated to produce the final product. Below are the set of conceptual designs to be studied and evaluated;

1. **The use of wind energy as an alternative source**; Wind power is basically the use of windmills to generate electricity. Wind energy is a popular, sustainable, renewable power supply that has a tons smaller influence on the surroundings than burning fossil fuels.

fig 1.7

2. **Making use of the sun's energy through solar panels**; With this, energy from the sun is made utilized to produce electricity using a device called the solar panel.


fig.1.8

3. **Making use of the earth's energy which is termed geothermal energy**; This energy is been produced as a result of heat generated within the earth's core. This energy can be used to generate electricity as well to help stop the power outages in my community.


fig.1.9

EVALUATION TABLE

KEY
M=MAGNITUDE
S=SCORE / 10
V=VALUE / 1

OBJECTIVES	PARAMETERS	WIND ENERGY			GEOTHERMAL ENERGY			SOLAR ENERGY		
		M	S	V	M	S	V	M	S	V
Manufacturing	The methods of processing	Good	7	0.6	Average	5	0.6	Excellent	9	0.8
Cost of parts	How much its parts cost	poor	4	0.5	Average	4	0.5	Average	5	0.6
Maintenance	Simplicity of servicing	poor	4	0.3	Good	5	0.5	Average	6	0.5
Environmental impacts	Its effects on the environment	Good	7	0.5	poor	3	0.4	Excellent	8	0.7
Durability	How long it will last	Excellent	8	0.8	Excellent	7	0.8	Excellent	9.5	0.9
Overall utility value				2.7			2.8			3.5

Fig.2.0

CHAPTER THREE
FINAL CONCEPTUAL IDEA
THE SOLAR PANEL
An assembly of photovoltaic solar cells set in a frame (often rectangular) is known as a solar cell panel, solar electric panel, photo-voltaic (PV) module, PV panel, or solar panel. A neatly arranged collection of PV panels is known as a photovoltaic system or solar array. Sunlight is used by solar panels to collect radiant energy, which is then transformed into direct current (DC) power. A photovoltaic system's arrays can be used to produce solar power that either directly powers electrical equipment or, through the use of an inverter system, is sent back into the alternating current (AC) grid.
The photovoltaic effect allows photovoltaic modules, which are made up of several solar cells, to produce electricity from the sun's light energy (photons). Thin-film or wafer-based crystalline silicon cells are used in the majority of modules. The top layer or the back layer of a module may serve as the structural (load-bearing) member. Cells need to be shielded from moisture and mechanical harm. Although thin-film cell-based semi-flexible modules are also available, most modules are stiff. Electrical connections between the cells are often made in series to achieve the necessary voltage and then in parallel to boost current. The mathematical combination of the module's voltage (in volts) and current (in amperes) results in the power (in watts) of the module.
The normal solar panel does not produce electricity when there is a power outage since it’s been connected to the grid but with this, the solar panel would be able to provide electricity because it’s not connected to the grid and it comes with a battery-backed up system to store some of the energy been produced during the day which can be later utilized during power outages in my community.

Materials used

1. Aluminium frame
2. Tempered Glass
3. Encapsulant-EVA
4. Solar cells
5. Back sheet
6. Junction Box

Fig 2.1

Construction of the solar panel

It is a junction diode, the solar cell. A solar cell is built differently than a typical p-n junction diode. A thick n-type semiconductor is first permitted to come into contact with a thin layer of a p-type semiconductor. Following that, a few finer electrodes are put into the p-type semiconductor.
These tiny electrodes don't block the light's path to the fragile p-n junction in any way. Additionally, a current-collecting electrode is positioned at the n-type layer's base.
In order to prevent mechanical shocks in the solar cell, manufacturers can also encase the system in a thin glass shell. It is possible to mount the enclosed solar cells in an aluminum frame with a Tedlar back sheet.

Components of the solar panel and their operations

1. **Solar cells**: Solar PV cells convert sunlight directly into direct current (DC) electricity. The characteristics of the silicon used and the type of cell used, with monocrystalline and polycrystalline silicon being the two main types, determine the performance of the solar panel.

2. **Tempered Glass**: The PV cells are shielded by the front glass sheet from the elements, including hail and airborne debris. The glass is normally 3.0 to 4.0mm thick and made of high-strength tempered glass that is made to withstand mechanical loads and drastic temperature changes.

3. **Aluminium Frame**: In order to install the solar panel in place and to protect the edge of the laminate part housing the cells, the aluminum frame performs a critical role. The extruded aluminum parts are made to be incredibly rigid, lightweight, and able to withstand severe wind and other external stresses.

4. **Encapsulant-EVA**: The term "EVA" stands for "ethylene vinyl acetate," and it refers to a specifically created, very transparent

polymer (plastic) layer that is used to enclose the cells and hold them in place during manufacturing. Because it plays a crucial role in long-term performance by preventing moisture and dirt infiltration, the EVA material must be exceptionally resilient and tolerant of high temperatures and humidity.

5. **Back sheet**: The back sheet, which is the layer of most typical solar panels that are at the back, serves as the last external skin, a moisture barrier, and a mechanical and electrical insulator. Different polymers or plastics, such as PP, PET, and PVF, are used to make the back sheet material. These materials provide varying degrees of protection, thermal stability, and long-term UV resistance.

6. **Junction Box**: On the back side of the panel, there is a small weatherproof container called the junction box. The cables used to connect the panels must be fastened firmly. The junction box is crucial because it serves as the hub for connecting all of the cell sets and must be shielded from moisture and debris.

WORKING PRINCIPLE OF AN OFF-GRID SOLAR SYSTEM

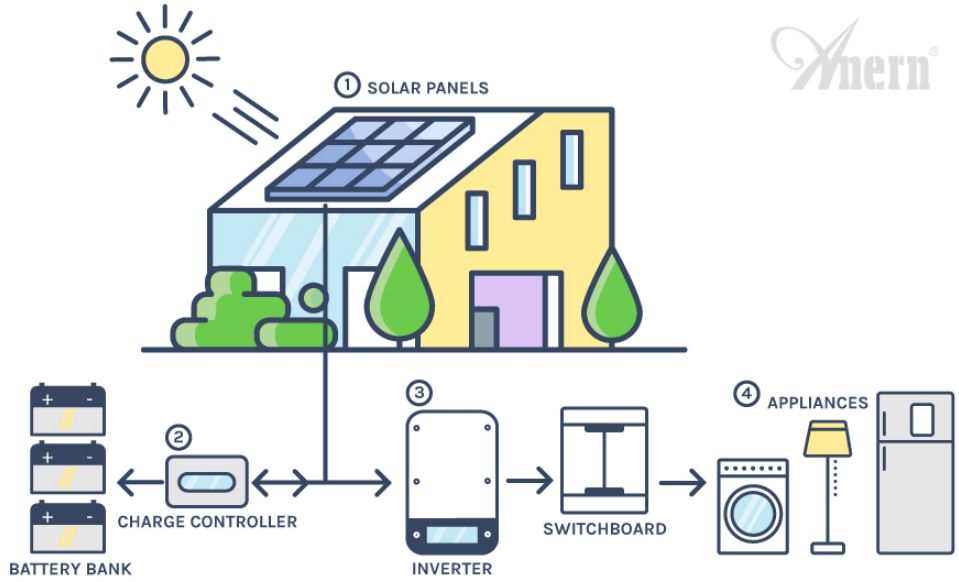

Fig.2.2

A photovoltaic array made up of solar cell modules, a solar charge and discharge controller, a battery pack, an off-grid converter, a DC load, and an AC load typically make up an off-grid solar PV system. When it is light, the photovoltaic array transforms solar energy into electric energy and, while simultaneously charging the battery pack, sends electricity to the load using a solar charge and discharge controller. The battery pack powers the DC load through the solar charge and discharge controller when there is no light. In the meantime, the battery also directly powers the independent inverter, which converts DC electricity into AC power and feeds it to the AC load.

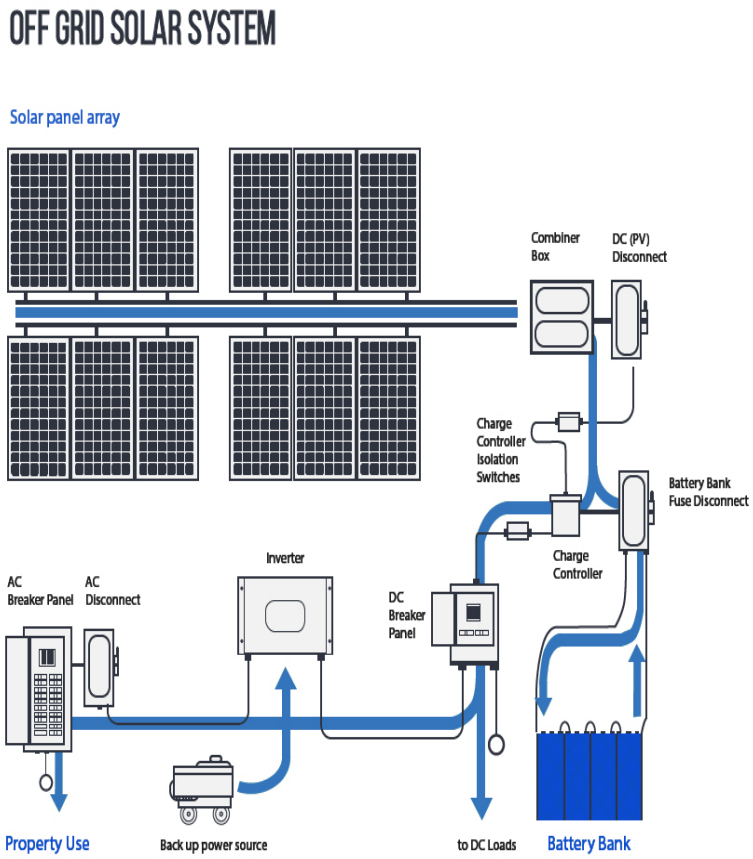

Fig.2.3

Below is a photo an off grid solar system design

CHAPTER FOUR

CONCLUSION

After carefully examining the problem of power outages in half Assini, the best solution was the construction of the solar panel with off grid power system which can even power our various homes and the entire community when there is a power outage. The solar panel has less effects on our environment and also help prevent pollution that could have been generated by the other conceptual designs. Therefore I can boldly say the off grid solar system is best reliable in solving such problem at hand.

RECOMMENDATION

I would therefore like to recommend this to the assembly of the

community to make this off grid solar system set up accessible to the entire community to help stop this power outages in Half Assini to make life more comfortable in the community.

CHAPTER FIVE

REFERENCE

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4. https://www.google.com/search?client=firefox-b-d&q=off+grid+solar+system
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6. https://www.anerngroup.com/uploads/image/20210929/how-does-off-grid-solar_system-work.jpg

CHAPTER SIX

APPENDIX 6.1

Copy Of Questionnaire

A Survey On Frequent Power Outages/ Electricity Blackouts

Dear Participant,
I am inviting you to take part in this research by completing the survey below. The aim of this research is to investigate the scope, characteristics, and nature of the occurrence of electricity blackouts/ power outages in Half Assini and to suggest long-lasting solutions. The survey is being conducted as part of the Engineering in Society research project taken by engineering students at KNUST.
Thank you for taking the time in assisting me with this research. Under no circumstances are you obliged to answer any of the questions, however, doing so will greatly assist me in completing my research and enhancing my understanding of this research focus. It will take you approximately 5-10minutes. The data collected will remain confidential and used solely for academic purposes.
Sincerely,

Name: Amstrong Donkoh
BSc. Mechanical Engineering,
Faculty of Mechanical and Chemical Engineering
KNUST
Supervisor: Prof. Faisal Adams

Part A: Demographic

Circle the most appropriate alternative and provide an answer where necessary

1. Age
A. Below 10
B. 10-17
C. 18-24
D. 25-40

E. Above 40
2. Gender
A. Male
B. Female
3. Are you a resident of Half Assini?
A. Yes
B. No
4. If yes, how long have you stayed here?
A. Less or up to a year
B. 2 to 5 years
C. More than 5 years
5. Level of education
A. Basic School
B. Senior High
C. Tertiary
D. Had no formal education
E. Prefer not to say
6. Occupation _____

_____

_____

7. How would you define the standard of living of your family from an economic perspective?
A. Low
B. Medium-low
C. Medium
D. Medium-high
E. High

Part B: Knowledge of problem

Circle the most appropriate alternative and provide an answer where necessary. For questions you are supposed to tick, you are at liberty to choose more than one alternative.

8. Have you heard of the term "**electricity blackout**" or "**power outage**"?
A. Yes
B. No
9. Do you know what the term in (B.8) above means?
A. Yes
B. No
10. If yes, write what you think it means. _____

_____

_____

11. Would you say electricity blackout is the biggest developmental challenge in the community?
A. Strongly agree
B. Agree
C. Maybe
D. Disagree
E. Strongly disagree
12. Which of these is also a developmental challenge in the community?
□ Poor plastic waste management
□ Prevalence of potholes
□ Poor Road maintenance

□ Air pollution
□ Other (please specify):

13. Would you say the blackout is more important, and of more concern than the problems mentioned
in (B.12) above?
A. Strongly agree
B. Agree
C. Maybe
D. Disagree
E. Strongly disagree

Part C: Nature and Scope of problem

Circle the most appropriate alternative and provide an answer where necessary. For questions you are supposed to tick, you are at liberty to choose more than one alternative.

14. How often are the blackouts?
A. Every day
B. Every other day
C. Occasionally
D. Cannot really tell

15. When was the last time there was a blackout?
A. Today
B. Yesterday
C. About a week ago
D. It has been a while
E. Cannot really tell

16. Have you noticed a pattern when the blackout normally occurs?
A. Yes
B. No

17. If yes, please describe the pattern below

18. Is there a specific time of the day the blackout normally occurs?
A. Yes
B. No

19. If yes, specify the time range below

20. Can you specify the length of the longest blackout you have experienced?
A. Yes
B. No

21. If yes, specify below

22. What do you think is/are the cause(s) of the blackout?
□ Poor governance
□ High energy demand
□ Equipment failure

□ Weather and natural disasters
□ Wastage of electricity/ lack of energy conservation
□ Other (please specify):

---

23. Below, some potential blackout-related inconveniences are listed. Please select which of these you have experienced before.
□ Damage to appliances
□ Loss of data from your PC
□ Remaining stuck in an elevator
□ Remaining stuck in a closed room
□ Spoiled food in the fridge
□ Inability to cook
□ No Heating and air conditioning
□ Inability to watch TV
□ Inability to use the PC
□ Interrupted telecommunications
□ Suddenly remaining in the dark
□ Other (please specify):

24. How would you describe this issue of the blackout?
□ Urgent
□ Important
□ Neither

Part D: Reaction to problem

Circle the most appropriate alternative and provide an answer where necessary.
For questions you are supposed to tick, you are at liberty to choose more than one alternative.
25. Have you made complaints to municipal/district/ town officials of this issue?
A. Yes
B. No
26. If yes, what was their response?

---

27. Have you made complaints to the Electricity Company of Ghana?
A. Yes
B. No
28. If yes, what was their response?

---

29. Do you have an alternate source of power in your home?
A. Yes
B. No
30. If yes, specify below

---

31. In an event of a blackout what do you do?
□ Switch to an alternate power source
□ Wait for the electricity to come back on
□ Call the ECG office
□ Other (please specify):

---

32. Which of these proposed solutions do you think can solve this problem?
□ Wind energy
□ Solar energy using the off-grid system
□ Geothermal energy

33. Propose any other solution(s):

END
THANK YOU!

□

APPENDIX 6.2

Kwame Nkrumah
University of Science
and Technology, Kumasi

College of Engineering

OFFICE OF THE PROVOST

Our Ref: CoE-PO/CENG291/

Date: November 14, 2022

TO WHOM IT MAY CONCERN

Dear Sir/Madam,

LETTER OF INTRODUCTION

The bearer of this note is a First Year Engineering student of the College of Engineering conducting a project in a course titled "Engineering in Society'.

The overall aim of the course is inculcating in students, an appreciation of the fact that, the purpose of Engineering is to solve societal problems. This course is aimed at encouraging students early in the programme of study to draw a link between their chosen field of Engineering and the application of this field to the issues that confront the day to day lives of people.

We should, therefore, be most grateful, if you could facilitate his/her data collection and provide any other assistance that he/she may need.

Counting on your usual cooperation.

PROF. GEORGE YAW OBENG
FOR: PROVOST

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