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Profitability Strategies of Solar Energy Businesses in Lagos, Nigeria

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This is to certify that the doctoral study by

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Abstract

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Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Some solar energy companies in Nigeria are not profitable because of ineffective marketing and sales strategies on the part of the business leaders and challenging operating environments. The ability to craft strategies that ensure the adoption of solar energy solutions by households is pertinent to the profitability of the solar energy business. Grounded in Rogers's diffusion of innovation theory, the purpose of this qualitative multiple case study was to explore strategies solar energy business leaders in Lagos, Nigeria, use to maintain a profitable business. The participants included six solar energy business leaders in two companies from Lagos, Nigeria. Data were collected from semistructured interviews and company document reviews. Data were analyzed using Yin's 5-phase cycle, which guided the coding process, where 4 major themes emerged: create awareness for solar using personal selling, social media, and online channels; offer attractive financing options; participate in rural electrification projects; and partner with distributors and agents. The implications for positive social change include the potential reduction of energy generation and consumption on climate as more households adopt solar energy solutions. A profitable business can increase the ability of companies to financially address social issues such as electrification in rural areas, electricity instability in urban areas, job creation, and poverty reduction.

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Dedication

I dedicate this study to my God Jehovah, who gave me the strength to persevere throughout this journey and be able to complete it. I also dedicate this study to my wife, Olajumoke, whose love, support, and prayer helped me to make this dream of achieving a doctorate degree a reality. It was a long journey full of challenges and sacrifices, and she stood by me. I also appreciate the understanding shown by my children, Nifemi, Fikemi, and Fikunmi, when many times during the journey I was not available for them, but always on my laptop working. May God also reward the good deeds of all who supported me during this journey. Thank you all and God bless.

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Table of Contents

List of Tables v

Section 1: Foundation of the Study 1

Background of the Problem 2

Problem Statement 2

Purpose Statement 3

Nature of the Study 3

Research Question 4

Interview Questions 4

Conceptual Framework 5

Operational Definitions 6

Assumptions, Limitations, and Delimitations 7

Assumptions 7

Limitations 7

Delimitations 8

Significance of the Study 8

Contribution to Business Practice 8

Implications for Social Change 9

A Review of the Professional and Academic Literature 9

Critical Analysis and Synthesis of the Conceptual Framework 10

Related Theories Supporting the Diffusion of Innovation Theory 12

Contrasting Theories to the Diffusion of Innovation Theory 13

Critical Analysis and Synthesis of Literature Pertaining to Solar Energy Technology 14

History and Evolution of Energy Production Processes 15
Comparison Between Evolution of Coal and Solar Energy 17
Energy Delivery Process and Challenges 18
Effect of COVID-19 Pandemic on the Delivery of Energy 24
Future Policy of Energy Production and Distribution 25
Impact of Policies on the Production, Distribution, and Delivery of Solar Energy 27
Challenges of Policy Implementation 29
Benefits of Solar Renewable Energy Technology 29
Drawbacks of Renewable Solar Energy Technology 34
Looking Ahead on Solar Energy Technology 36
Role of Business Leaders and Governments in Adoption of Solar Energy 38
Transition and Summary 43
Section 2: The Project 44
Purpose Statement 44
Role of the Researcher 44
Participants 47
Research Method and Design 49
Research Method 49
Research Design 49
Population and Sampling 51
Ethical Research 53
Data Collection Instruments 54
Data Collection Technique 56
Data Organization Technique 59

Data Analysis 60
Reliability and Validity 62
Dependability 63
Credibility 64
Transferability 64
Confirmability 65
Data Saturation 66
Transition and Summary 66
Section 3: Application to Professional Practice and Implications for Change 67
Introduction 67
Presentation of the Findings 67
Theme 1: Create Awareness for Solar Using Personal Selling, Social Media, and Other Online and Digital Channels 71
Theme 2: Offer Attractive Financing Options 73
Theme 3: Participate in Rural Electrification Project Targeted at Low Income Households and Product Diversification 76
Theme 4: Partner With Distributors and Agents and Provide After Sales Support 80
Findings Related to the Conceptual Framework 84
Applications to Professional Practice 86
Implications for Social Change 88
Recommendations for Action 89
Recommendations for Further Study 93
Reflections 94
Summary and Study Conclusions 95

References.....97

Appendix A: Semistructured Interview Protocol and Interview Questions.....131

List of Tables

Table 1. Coding of Participants' Responses Related to Themes 70

Section 1: Foundation of the Study

The demand for electricity throughout the developing and developed world continues to rise due to businesses requiring electricity to power them (Kessides, 2012). Specifically, consumers in many parts of Africa are demanding 24 hours of electricity on daily basis to be able to run their businesses and power household equipment (Ley et al., 2015). In some nations, government establishments are responsible for the management of the generation, transmission, and distribution of electricity through the national grid, and many have failed in this responsibility (Energypedia, 2020; Oladipo et al., 2018; Sambo et al., 2010). Some business leaders in the private sector have sought to solve this problem.

Some business leaders in the private sector have developed strategies to meet their needs using the development in renewable energy technology, in particular solar energy (Anubha, 2013; Maradin et al., 2017). Solar energy refers to a means of generating electricity using solar cells or photovoltaic cells to convert the energy of light from the sun directly to electricity (Ndagijimana et al., 2019). One of the strategies used by the business leaders is to deploy solar energy technology in a way that households and private businesses can afford the cost of solar panels and the total initial cost of solar energy implementation (Gorevaya & Gorevoy, 2016; Wakeford, 2018). Some business leaders have been able to remain profitable using this approach, whereas others lack strategies and are struggling to keep their business afloat. Researchers can explore how business leaders develop strategies that can help them maintain profitability in the business so that their companies can be successful.

Background of the Problem

A good source of electricity is one that is available, clean, and renewable, and the use of such energy can result in a reduction in greenhouse gases, increased energy independence, and improvement in the quality of life (Hernandez et al., 2014). However, in some nations, electricity is not available for many hours in a day (Ley et al., 2015). Many nations still generate their electricity using fossil fuel sources of energy because of the abundance in nature in their environments (Fernando & Yahya, 2015; Wang & Economides, 2009).

Because of the challenges households and businesses are facing to access constant and uninterrupted electricity, some business leaders have recognized the need to generate electricity using alternative sources of electricity (Kessides, 2012; Ndagijimana et al., 2019; Revankar, 2019). While some business leaders have struggled to craft strategies on the best way to generate electricity using an alternative energy source, other business leaders have developed strategies to ensure the availability of electricity using solar energy, which results in the profitability of their business. Some solar companies are unable to make a profit out of their extensive investment in time and money (Fernando & Yahya, 2015). New research may lead to strategies that solar energy companies can use to generate and maintain the profitability of the business while implementing solar energy for the community.

Problem Statement

In 2019, electricity in Nigeria was accessible, on average, only 45% of the day (U.S. Agency for International Development, 2019). The electrification rate in Nigeria is only 55%, which means that almost half of Nigerians lack access to consistent and efficient electricity, despite an abundance of sunshine suitable for generating

electricity using solar energy technology (African Development Bank, 2018; PM News, 2019). The general business problem was that despite the proliferation of solar energy technology, several solar energy companies in Nigeria are not profitable (Tilleard et al., 2018; World Economic Forum, 2019). The specific business problem was that some business leaders who manage solar energy companies catering to households in Lagos, Nigeria, lack strategies to maintain a profitable business.

Purpose Statement

The purpose of this qualitative multiple case study was to explore strategies that some business leaders who manage solar energy companies that cater to households in Lagos, Nigeria, use to maintain a profitable business. The targeted population was six business leaders in two solar companies in Lagos, Nigeria, who yielded positive returns on their investments. The profitability of solar energy businesses will likely lead to the proliferation of solar energy use in households, which could have a positive effect on consumers' quality of life, the environment, and the economy.

Nature of the Study

Researchers can use one of three research methodologies to carry out a scholarly study: quantitative, qualitative, or mixed (Saunders et al., 2015). The qualitative method was the most appropriate for this study. Qualitative researchers explore topics using open-ended questions (Mohajan, 2018), whereas quantitative researchers statistically examine variables' characteristics or the relationships between two or more variables (Oberiri, 2017). Researchers conducting a mixed-methods study combine qualitative and quantitative research (Almalki, 2016). This study did not require collecting and analyzing quantitative data from the participants, therefore,

quantitative and mixed methods research were not appropriate. Hence, I selected a qualitative methodology.

A single case study addresses a business phenomenon within one organization, whereas a multiple case study explores a business phenomenon within more than one company (Yin, 2018). I selected a qualitative multiple case design for this study to explore the business leaders' strategies for profitability in two different solar energy companies. I also considered narrative, ethnographic, and phenomenological designs. Narrative researchers focus on the personal stories of study participants (Kourti, 2016), which did not align with the goals of this study. Ethnographic researchers study a groups' culture, social world, and activities over some time (Saunders et al., 2015), which was not the intent of this study. The final design consideration was phenomenology, which involves inquiring about the personal meanings of the participants' lived experiences related to a phenomenon and the recollections and interpretations of those experiences (Kaszynska, 2015), which I also concluded was not appropriate to meet the goals and objectives of this study.

Research Question

What strategies do business leaders of solar energy companies that cater to households use to maintain the profitability of their business in Lagos, Nigeria?

Interview Questions

1. What strategies have you used to achieve and maintain profitability using your chosen business model?
2. What strategies did you use to communicate the need for, and benefits of, solar energy to potential customers?

3. How did you assess the effectiveness of your strategies for achieving and maintaining profitability?
4. What were the key obstacles to implementing your organization's strategies in maintaining profitability using your chosen business model?
5. How did your organization address the key obstacles to implementing its strategies?
6. What strategies did you use to identify factors that influence how quickly residents are adopting solar energy?
7. What else can you share with me about your organization's strategies for achieving and maintaining profitability from serving its household customers?

Conceptual Framework

The diffusion of innovation theory was the conceptual framework selected for this study. Innovation is an idea perceived as new. Thus, the definition of diffusion of innovation is the spread of a new idea via certain communication channels among people within a social system (Rogers, 2004). The theory assumes that the social system members are heterogeneous regarding their willingness to adopt innovation. By processing a large amount of data, Rogers (2004) came up with five characteristics of innovation: (a) relative advantage, (b) compatibility, (c) complexity, (d) trialability, and (e) observability. The characteristic of compatibility within Rogers's diffusion of innovation theory is the extent to which an innovation is consistent with prior experiences, current values, and future needs of the potential consumer of the innovation (Kapoor & Dwivedi, 2020). Therefore, the diffusion of innovation theory was an appropriate lens for viewing, analyzing, and understanding the strategies the

participating organizations' leaders used to maintain the profitability of their business in Lagos, Nigeria.

Operational Definitions

Electrification rate: The electrification rate is the rate of providing electricity for households and businesses through the national grid powered mostly by fossil fuels or through alternative sources of energy (Akhator et al., 2019).

Greenhouse gas emissions: Greenhouse gas emissions are gases that trap heat in the atmosphere, thereby causing a warmer planet. Example of such gases are carbon monoxide and carbon dioxide (CO2), which are generated from burning fossil fuels, solid wastes, or other chemical or biological materials (Lallanilla, 2019).

Grid-connected system: A grid-connected system is a solar system that allows a household to power the house with the solar photovoltaics (PV) when the sun is shining and falls back to the electricity provided by the utility company when the sun is no longer available at night or during winter (Energy Saver, 2020).

National grid: The national grid is a utility company that manages the generation, transmission, and distribution of electricity and gas that power all homes and businesses (Davies, 2017).

Off-grid system: An off-grid system is a renewable solar energy system that can power a household without being connected to the electricity provided by the utility company (Energy Saver, 2020).

Pay-as-you-go model: The pay-as-you-go is a business model (Ritter & Pedersenin, 2020) of solar energy deployment to residents in which the solar provider finances the infrastructure and the homeowner makes regular payments in line with their consumption patterns (Yadav et al., 2019).

Profitability of solar energy business: The profitability of solar energy business is also known as the return on assets of the solar energy business, which is measured intrinsically as the capacity of the solar business to generate profit (Cheng & Mevis, 2019).

Solar energy technology: Solar energy technology is the process of generating electricity or heat from the sun using solar photovoltaic systems (Kassem et al., 2020).

Solar photovoltaic system: Solar photovoltaic is a system that converts sunlight into electricity directly using the PV panels (Kassem et al., 2020).

Assumptions, Limitations, and Delimitations

Assumptions

Assumptions are elements of a study a researcher accepts to be true without proof (Simon & Goes, 2018). In this qualitative study, the first assumption was that an appropriate method to explore the business problem was through a qualitative case study. After analyzing several qualitative designs, this assumption appeared to be correct. The second assumption was that the participants did not feel pressured to participate in the study. The third assumption was that the business leaders of the solar energy business understood the interview questions and voluntarily shared the strategies for profitability with the interviewer without manipulating facts. Because participation was voluntary and confidentiality was assured, the second and third assumptions were met.

Limitations

Limitations are potential weaknesses around a study that may affect the outcome and are usually out of the researcher's control (Theofanidis & Fountouki, 2019). These may be related to the research design, funding constraints, research

population, or limited access to data. The first limitation was the possibility of restricted participation from company leaders due to increased workloads, lack of interest, or lack of availability at the time of the interviews. Because the interviews were through video conferencing, the chances of finding convenient times increased. The second limitation was that the results of this qualitative multiple case study might not apply to other workplaces, populations, and industries, thereby affecting the ability to generalize the outcome of the study.

Delimitations

Delimitations are deliberate boundaries set by the researcher to establish a focus for the study (Theofanidis & Fountouki, 2019) so that the goals and objectives of the study could be achieved. One delimitation was the restriction of the study to solar energy businesses that cater to households instead of the businesses. Another delimitation was that the participants in this study needed to be business leaders in solar energy businesses. The third delimitation was the purposeful limiting of the study location to Lagos, Nigeria, and the final delimitation was restricting the sample population to two solar energy businesses that cater to households.

Significance of the Study

The goal of the case study was to identify and explore the strategies that business leaders of solar companies in Lagos, Nigeria, used to become profitable, and by doing so, have a positive impact on the environment and community.

Contribution to Business Practice

Business leaders may use the findings from this study to develop and implement strategies that will help them to make a profit and remain profitable while dispensing solar energy technology in the community. Using effective business

strategies is a key to driving the adoption of solar energy technologies that cater to households, which in turn can result in the profitability of the business (Gorevaya & Gorevoy, 2016; Jayaraman & Ling, 2017; Wakeford, 2018). Business leaders who use the findings from the study may achieve profitability in their solar energy business through reviewing, adopting, or adapting the participants' successful strategies.

Implications for Social Change

The findings from the study may contribute to social change. As more households adopt the use of solar technology for electricity and heating, they might also motivate others to benefit the environment by reducing carbon emissions (Gielen et al., 2019). Generating energy from solar panels emits very little pollution and is a cleaner source of energy than the burning of fossil fuels. Higher profitability also increases the ability of the business leaders to financially address social issues such as electrification in rural areas, electricity instability in urban areas, job creation, and poverty reduction (Gorevaya & Gorevoy, 2016).

A Review of the Professional and Academic Literature

The purpose of this qualitative multiple case study was to identify the strategies business leaders use to operate a profitable solar energy business. The focus of this research study was to reveal the strategies for profitability in solar energy companies that cater to the household. This literature review includes three main sections: (a) critical analysis and synthesis of the conceptual framework, (b) renewable energy technology, and (c) solar technology. Subtopics include theories supporting conceptual framework, theories contradicting the conceptual framework, history of energy development, the benefit of solar energy technology, adoption of solar energy, adoption of solar energy in the household, and profitability. Other

subtopics include the role of business leaders in energy production and delivery, energy production and social responsibility, energy delivery and social responsibility, the impact of energy production and delivery on the environment, and the impact of policies on energy production, distribution, and delivery.

Primary research databases included the ABI/INFORM Collection and Business Source Complete databases available through the Walden University online library. I located peer-reviewed publications for inclusion in this literature review by searching terms such as *solar, solar energy business, solar energy,* and *profitability* along with related concepts such as *carbon emission, diffusion of solar, energy delivery, energy production,* and *renewable energy*. With regards to the profitability of the solar business that cater to households, search terms included *household, solar business, profitability, pay-as-you-go,* and *off-grid solar solution.* The literature review includes 121 references, about 90% of which are peer-reviewed sources, with approximately 86% published between 2015 and 2020.

Critical Analysis and Synthesis of the Conceptual Framework

Qualitative researchers use a conceptual framework for their studies instead of a theoretical framework (Karlsson et al., 2019). The conceptual framework for this study was the diffusion of innovation theory introduced by Rogers (2003), which is a common theory in the field of innovation and adoption of new technologies (Kapoor & Dwivedi, 2020). Several elements determine the adoption of solar energy technology in households. For example, some households have been motivated to adopt solar energy technology because they believe that the innovation meets their expectations and social values (Kapoor & Dwivedi, 2020; Reyes-Mercado & Rajagopal, 2017). Other households have adopted solar energy technology because

their experience showed that the technology was not complex but easy to use, and it was consistent with their experience, making the technology easily adoptable (Kapoor & Dwivedi, 2020). Kapoor and Dwivedi (2020) explained the diffusion of innovation theory by highlighting the five characteristics of innovation: (a) relative advantage, (b) compatibility, (c) complexity, (d) trialability, and (e) observability.

Relative Advantage

Relative advantage in the diffusion of innovation theory explains the advantages in terms of product superiority and financial value the innovation may have over existing products, which may move the household to want to adopt the technology (Elmustapha et al., 2018). Some of the advantages that have motivated households are the clean nature of the energy and the relative cost, which is cheaper in the long run (Kapoor & Dwivedi, 2020).

Compatibility

Compatibility in the diffusion of innovation theory describes the extent to which the innovation is consistent with the customer's experience and social values, which can encourage the households to consider and adopt solar energy technology (Elmustapha et al., 2018; Reyes-Mercado & Rajagopal, 2017).

Complexity

Complexity relates to the ease of usage in comparison with existing technology. If solar system devices and equipment are not complex or difficult to use, then the adoption is likely to be considered by consumers to the extent that the innovation is easy to use (Kapoor & Dwivedi, 2020).

Trialability

Trialability measures the extent to which an innovation or product can be tried and tested by the consumer to confirm if it meets their expectations. The concept also portends using innovation for a limited period before making an adoption decision (Kapoor & Dwivedi, 2020). If solar energy household equipment is not trial-able, then the decision to adopt or not by the household may be affected. When an innovation allows experimentation, it will be more readily adopted by users (Hayes et al., 2015) as they believe it will save them from making an investment mistake.

Observability

Observability refers to the extent to which the households can see the values of innovation before making an adoption decision. The visibility of the benefits of innovation can increase the acceptance and adoption by a household (Hayes et al., 2015).

Related Theories Supporting the Diffusion of Innovation Theory

Several corresponding theories support the diffusion of innovation theory. These include social learning theory, social network theory, value-belief-norm theory, and theory of planned behavior. The social learning theory on diffusion of innovation explains that adopters need to be knowledgeable of a product and then be motivated to raise their awareness about it. The theory can be expanded for the understanding of the relationship between visual exposure to solar technology and the adoption intention of the households (Parkins et al., 2018).

The value-belief-norm theory also suggests that the root cause of pro-environmental behavior lies in values and emphasizes the importance of altruism directed at human and nonhuman entities (Parkins et al., 2018). The theory explains that because humans understand the effect of climate change and the effect it could

have on the environment, they feel a sense of obligation to address the concerns and hence are motivated towards adopting renewable energy solutions like solar to address it (Wolske et al., 2017).

The social network theory on diffusion of innovation explains that social interactions with early adopters of innovation have been found to influence others within the social networks. Early adopters of solar technology can share their positive experiences with others within their social network and encourage them to make an adoption decision. Community projects showcasing the use of solar energy to power infrastructures have also been seen to encourage the development of interest in solar technology (Parkins et al., 2018).

The theory of planned behavior portends that intention to perform a behavior is the outcome of a rational decision-making process that involves considering (a) one's attitudes toward the behavior, (b) perceived social pressure to do the behavior, and (c) an assessment of one's ability to meet the obligation (Wolske et al., 2017). According to the theory, attitudes form beliefs, and beliefs affect perceptions and decisions. If there is a perception that a technology like solar energy can have benefits such as reduced electricity cost, improved home value, and reduced environmental pollution, this can influence the adoption decision of the consumer.

Contrasting Theories to the Diffusion of Innovation Theory

One of such theories differing in approach from the innovation theory by Rogers is the resilience theory. This theory focuses on the relationship between innovation and overall sustainability and most importantly the resilience of the larger ecosystems where the innovation evolves. The theory focuses on the ecological and the social aspect of systems that can motivate people towards adoption (Jesse et al.,

2019). Another is the theory of change, which is an outcome-based approach. The theory of change focuses on the program designer of innovation to explicitly state how they expect their innovation to work. The implicit assumption of the program designer must be made explicit (Paina et al., 2017; Reinholz & Andrews, 2020). This allows an assessor to understand what is being implemented, why it is being implemented, and connections between the interventions and the outcome.

The diffusion of innovation theory was suited for the conceptual framework for this study as it aligned with the topic of the study. The focus of the theory is the characteristics an innovation must have for households to make decisions towards adopting the new technology (Kapoor & Dwivedi, 2020). In accord with this theory, when, for example, an innovation like solar energy technology meets the expectation of the household and there is a high level of awareness about it (Jayaraman & Ling, 2017), the adoption rate increases. When this happens, it has a positive relationship with the technology production and marketing. Higher adoptions lead to higher profitability for the businesses that manage the diffusion of innovation using various business models (Gorevaya & Gorevoy, 2016; Susman, 2008).

Critical Analysis and Synthesis of Literature Pertaining to Solar Energy Technology

Solar energy technology has gained increased popularity in recent times. This is not unconnected with the attention that has been given to it by business leaders, health practitioners, academic researchers, political leaders, and international organizations (Clemencon, 2016; Miyamoto & Takeuchi, 2019). The focus on solar energy and other forms of renewable energy has been reflected in various agreements

like the Kiyoto Protocol and the Paris Agreement that have been signed by many nations in recent times (Leis, 2019; Miyamoto & Takeuchi, 2019).

The advent of the COVID-19 pandemic has also highlighted the need to use the technology to provide stable, reliable, and clean electricity to health workers and patients who are recovering from the ailment (Hopper, 2020; Rural Electrification Agency HQ, 2020). There are new applications of solar energy solutions in isolation centers and hospitals during the pandemic assisting to provide uninterrupted power sources for the staff and patients recovering from the COVID-19 infection (Costello, 2020).

History and Evolution of Energy Production Processes

Coal production has evolved gradually since 1970 from local production and local consumption to international and big trade across continents (Trevino, 2020). The oil shock in 1973 triggered the need for the international trading of coal (Kubarych, 2005; Li, 2010). Oil and coal were two energy sources used to power electricity and plants, but when there was an upsurge in the price of oil, importation across the Atlantic was affected. People and countries started settling for coal (Trevino, 2020), which was an alternative and cheaper source of energy. After some time, however, the rising price of oil started to affect the price of steam coal (Li, 2010).

Another oil shock hit the global energy market in 1978 (Kubarych, 2005), consolidating the drive for seaborne steam coal to other countries as a major alternative to oil. The changes in the demand and supply conditions of the steam coal market have led to the development of the international steam coal market (Li, 2010). Over the years, several approaches have been used to manage the international trade

for steam coal. Earlier, long term contracts were used between producers and consumers, especially for consumers who used steam coal to operate base-load electricity generation. This was because they could not afford the scarcity of the commodity at any time. Over time, because of changing market circumstances, some consumers operating at mid load started to use long-term contracts that were adjustable on an annual basis (Baruya, 2015; Li, 2010).

As the stability in the production of steam coal continued, the spot contract approach was used by some consumers, especially in the Atlantic market. The price for the cargo to be shipped was what was paid for, and if the price was cheaper than the long contract price, then the consumer could decide to buy enough that would cover them for a period of time and save some money (Baruya, 2015). Because it is the forces of demand and supply that determine the spot price at any time, this became a preferable option for many consumers, especially in the Atlantic and Asian markets (Baruya, 2015; Li, 2010).

Oil and gas have been other sources of energy for use in petrochemicals and powering up turbines and generating electricity. The origin of crude oil can be traced to several decades ago when oil extracted from crude oil was used for domestic energy consumption. In the early 1960s in Saudi Arabia, there was no developed market for natural gas, and as such, natural gas was reinjected into the oil field as a by-product or even flared (Albqami & Mathis, 2012). However, over time, because of the fluctuations in oil prices and the cheaper price of natural gas, this source of energy has evolved to be a preferable energy option to power electricity installations.

While crude oil is found in most places in the world, natural gas is found mostly in the middle east where there is much political instability. About 41% of the

world's natural gas is concentrated in Iran and Qatar (Albqami & Mathis, 2012; Esen & Oral, 2016). Over the years, the production of natural gas has increased because of the discovery of nonassociated gas, which is also used in many countries to satisfy the growing energy demand. Production of natural gas, both associated and nonassociated, has moved from local consumption to exportation as more and more demands come for the replacement of fossil energy with cleaner energy sources. The world is also moving towards the use of less expensive associated natural gas instead of fuel to generate power and use in other petrochemical productions. About 50 to 60% of natural gas production in a country like Saudi Arabia is linked with the production of oil or located in the crude oil fields; thus, as oil production increases, natural gas production increases (Albqami & Mathis, 2012).

Comparison Between Evolution of Coal and Solar Energy

Coal is one of the energy sources that exist in nature and its production has spanned several decades from local production and local consumption to seaborne steam coal for importation and exportation (Kubarych, 2005; Li, 2010). On the other hand, humankind has always used the energy from the sun for heating, drying, and lighting fire in the pre-modern era (Szabo et al., 2017). The sun is used for drying and preserving food. The sun was used in the prehistory era for causing evaporation of seawater to obtain salt and in later centuries many scientists have built numerous innovations around the sun to collect, store and transfer the solar rays for heat energy generation (Szabo et al., 2017).

The modern-day solar-based energy started in 1839 when Alexandre-Edmond Becquerel (1820-1891) discovered the photovoltaic effect (Szabo et al., 2017) which later formed the basis for the design and production of solar photovoltaic (PV) cells

which have now been developed in the last decades because of modern technology and it is undergoing growth and rapid acceptance (Hernandez et al., 2014). While steam coal evolved because of a need for energy for domestic and commercial use, solar power has evolved because of man's need for a cleaner source of energy that has less risk, free of pollution, and contribute positively towards reduction in global warming (Litovsky & Bickmeyer, 2015; Reddy, 2003).

While steam coal became acceptable because it was a good alternative for oil in powering plants and electricity installations, solar energy is becoming acceptable also because it is environmentally and economically attractive (Hernandez et al., 2014). The commercial concentrating solar power can be used to generate electricity in commercial quantity, and it is undergoing rapid development (Kessides, 2012). While there have been governments unwillingness to subsidize domestic coal production (Li, 2010), there has been a high level of willingness on the part of the governments to subsidize the production of solar panels (Lopez et al., 2020; Min et al., 2019) because this source of energy generates clean power, no air or water pollution, no waste product and because the energy is renewable by sunlight irrespective of where one may be living on the earth.

Energy Delivery Process and Challenges

The energy delivery process is a major part of the energy management system. For energy to be useful, it must be delivered in a safe, reliable, affordable, clean, and efficient way to the consumers where, when, and how they want it (Sissine, 2016). The different ways of delivering various energy sources to their destinations where they will be consumed are discussed below.

Oil and Gas

Infrastructures have been built for petroleum products to be transported from the refineries and be delivered to the depots through pipelines, railroads, tank cars or tankers, ships, and barges in a safe and secure way (EnergyAPI, 2020; Kuklina et al., 2020). There are big trucks that lift oil and gases from the depots to the different petrol and gas stations across the countries. The importance of oil and gas to economies and life cannot be overemphasized (appea, 2020; Stein, 2020). Oil and gas are used to power electricity that is delivered to various homes and businesses through the base stations via the central grid systems. There are various other derivatives from oil processing that are used in every aspect of life (Stein, 2020).

Oil and gas are delivered to homes through filling stations (gas or petrol) around the communities. People go to the filling stations to buy gas, petrol, and lubricants for their engines (cars, trucks, planes, etc.) and to store inside containers for generating sets to use to power farmhouses, equipment, homes, and businesses. Homes and businesses use oil (e.g., diesel) to power cars, trucks, and vehicles. Gas is used to generate electricity for cooking, heating houses, buildings, and water (appea, 2020; World Petroleum, 2020). Tens of thousands of people work in the oil and gas industry (World Petroleum, 2020).

Some major challenges faced in the delivery of oil and gas include pipeline vandalism and its attendant effects such as fire outbreak and gas emissions in the environment which can affect human and plant health. The vandalism is usually a result of cultural, economic, and political issues among leaders and youths in the communities where oil is produced and refined (Nwanya et al., 2018). Other challenges include theft, road accidents of trucks because of lack of enforcement of the traffic laws, and recklessness of the articulated vehicles carrying fuels (petrol, gas,

and diesel) from the port to other locations resulting to loss of lives and properties (The Guardian, 2018).

Hydropower

This is energy generated from water. Hydropower was one of the first sources of energy used for electricity, and until 2019 was the leading source of renewable electricity generation in many nations (U.S. Energy Information Administration, 2020). The electricity generated is transported to the consumer through the electric utility grid which is a system in which power providers and consumers are connected in a synchronized manner by transmission and distribution lines and operated by one or more control centers (U.S. Energy Information Administration, 2020).

Some of the challenges faced in some countries in the delivery of this energy source to the consumer have been an overload of the transmission network, right of way negotiation and payment, community security issues, non-performing engineering, high cost of grid extension, and huge manpower deficits. The distribution grid also suffers from high technical and non-technical losses, electricity equipment theft, lack of skilled distribution of sub-station operators, vandalization of transmission equipment, distribution and transmission interfaces issues, poor feasibility study of electricity utility, obsolete power infrastructure, and poor metering (Energypedia, 2019; Nwanya et al., 2018).

Other challenges faced in the delivery of electricity generated using hydro sources are the displacement of people from their homes for those who live in the vicinity of the hydropower plant. Sometimes, because the power plants are artificially created, it can lead to flooding when the waters are released displacing more and more people from their homes and also affecting rivers ecology (Owusu & Asumadu-

Sarkodie, 2016). Electricity transmission and distribution infrastructure that carries electricity from the power plants to the consumers do have environmental effects. Most transmission lines are above the ground on large towers and therefore alter the visual landscape of the environment because people are not allowed by regulation to build any structure under such power lines. Also, vegetation under and around power lines is continually managed thereby affecting native plant population and wildlife (Energy Information Administration, 2018). The delivery of energy through the utility grid has also been found to be time-consuming and very expensive (Kyte & Skierka, 2017), hence the reasons some rural communities do not have access to national electricity.

Wind Energy

This is a renewable source of energy generated from the wind using the wind turbines and delivered to the homes and businesses through the mini-grid and the national grid (Wagner, 2017). A wind farm is created onshore or offshore by the installation of tall and powerful wind turbines that rotate slowly but steadily using preferably high wind speed which is then converted to electric energy. When installed on the land in a wind farm, the energy generated from the wind turbines is transmitted via land cables to a transformer substation before being sent to the national grid. When installed on the sea the energy is transmitted through undersea cables, but an internal electricity grid is required first which is fed into an offshore transformer substation. From this substation, powerful undersea cables are used to transmit the electric energy generated onshore before being fed into the national grid (Wagner, 2017).

Some challenges associated with the delivery of wind electric energy include the high cost of cables required to deliver energy from the wind turbines to substations and finally to the grids especially when the turbines are installed offshore (Wagner, 2017). Others include the landmass required to set up a wind farm, the humming noise, and the effect on the floras and faunas. Also return on investment on wind farm project can take between 10 to 15 years before the investor can begin to see a financial return on the investment which makes project and investment in wind energy generation less attractive to individuals and small business except if it subsidized by the government so that it can be competitive in pricing with electricity generated from fossil fuels (Bakhshi & Sandborn, 2018).

Solar Energy

Solar energy is the third most important source of renewable energy after hydroelectric and wind power (Yun et al., 2019) This is energy generated from the sun and is delivered to the homes and businesses through a direct connection between the electrical system of a building, PV cells, the inverter, and the batteries storing the energy (Athena Information, 2018; Faris, 2015). It can also be delivered to homes and businesses through off-grid, semi-grid, or national grid arrangement (Anubha, 2013; Ndagijimana et al., 2019; Praveen, 2014; Sun & Egbelakin, 2014). The PV absorbs the energy from the sun in form of direct current and then pass it to the inverter that converts to alternating current which is then used to power equipment both in homes and offices (Holmes & Fletcher, 2015; Shaikh et al., 2017).

One of the major reasons why the delivery of solar energy is important is because the electricity from the grid is not always available in many locations especially in Africa where rural communities do not always have access to the

electricity from the grid because of the cost of grid extension (Energypedia, 2019; Ndagijimana et al., 2019; Wakeford, 2018). One limitation of the solar system is its inability to be linked to the national grid in some locations so that it can be economically viable to homes and businesses producing excess which they can sell to the national grid for other consumers (Giuseppe, 2015; Kiprop et al., 2019). Another limitation is in the quantity of electricity it can generate vis-a-vis the amount of investment on the system (Anubha, 2013; Renewable Resources, 2016).

It is generally believed that energy delivered through oil and gas are delivered more efficiently because of the availability and the quantity that can be delivered (Jayaraman & Ling, 2017; Wang & Economides, 2009). However, in terms of environmental friendliness, solar energy is preferrable. Also, in terms of the cost of implementation to the consumers and businesses, solar energy is still quite expensive vis-à-vis the quantity of energy that can be generated when compared to the quantity generated from oil and gas.

Some of the challenges with the delivery of solar energy are the high cost of equipment and the intermittent nature of renewable energy resources (Kiprop et al., 2019). Some researchers have however argued that the cost of delivery of solar energy becomes cheaper comparatively in the long run (Kapoor & Dwivedi, 2020; Okedu et al., 2015; Sun & Egbelakin, 2014). Other challenges include low marketing and awareness creation about solar energy systems in some countries by the manufacturers and solar companies (Jayaraman & Ling, 2017). In some countries, the electricity generated from fossil fuels is heavily subsidized by the government which has resulted in low tariff, and because electricity is available and stable, the desire by the people for an alternative source of energy is low. This means that the price of

electricity generated from solar will be more expensive when compared to those generated from fossil fuels (Bamgbopa et al., 2019; Jayaraman & Ling, 2017).

Other challenges include the profitability of the solar installations in the short term, the investment cost, lack of knowledge on the part of the employees thereby preventing investment by the companies, lack of infrastructure, and lack of technology by the service industries (Min et al., 2019; Sun & Egbelakin, 2014). Another challenge is government policies in some communities that fail to discourage investment in fossil fuels and encourage investment in renewable energy. Supplier involvement is found to be low in many localities and this has affected the social acceptability of the solution in these communities (Fernando & Yahya, 2015).

Effect of COVID-19 Pandemic on the Delivery of Energy

COVID-19 pandemic that started early in the year 2020 in most countries has affected the delivery of energy in many ways. Businesses and school closures across the planet have caused commercial and industrial electricity usage to decrease. However, stay-at-home orders likely increased the overall residential demand for electricity usage (Energy Information Administration, 2020).

Oil and Gas

The pandemic has badly affected the delivery of oil and gas across the world. This is because the demand for oil has dropped since the lockdown was declared. Almost every nation on the planet has been affected by the pandemic and most fossil fuel-related energy consumption activities like transportation and manufacturing have been grounded to a halt. This development has created an oil shock like the one experienced decades earlier (Severin, 2020). Production has been affected since

demand is low and this has resulted in price wars among the competing OPEC countries (Severin, 2020).

Solar Energy Technology

The pandemic has negatively affected the exchange rate of local currencies to dollars in many nations. Because of this, many solar projects were grinded to a halt in 2020 with expected ripple effects in years to come. Countries like South Africa, Australia, Mexico, and Brazil where installations were at the procurement phase were affected due to budget depreciation (Maisch, 2020). Years 2021 and 2022 may witness more reductions in financial investments on solar as orders for new equipment will halt from countries struggling to come out of the currency exchange rate dip in 2020 (Hopper, 2020; Maisch, 2020).

Some governments on the other hand have responded positively to the delivery of solar energy by offering tax deduction incentives for commercial and industrial solar PV operators to encourage the installation of solar energy by households to alleviate the financial pressure that can result from the use of grid electricity during this work from home engendered by the stay-at-home order by governments due to the COVID-19 pandemic (Green, 2020). Some other nations have also recognized the importance of investing in solar energy at this time to assist the already stretched electric grid as a backup in the hospitals and isolation centers where patients are recovering (Costello, 2020; Rural Electrification Agency, 2020).

Future Policy of Energy Production and Distribution

Energy policy refers to the intervention of the government and business leaders in ensuring the efficient production, delivery, and consumption of the various sources of energy available (Prontera, 2009). Energy policy further ensures the

current and future appropriate energy mix is in use in the correct proportions while considering the environment, the planet's climatic condition, and the temperature of the earth (Prontera, 2009). Energy policy can further be defined as a government-specific strategy to explore, exploit, manage, and preserve its diverse energy resources and portfolio to primarily satisfy its local energy demand. A good energy policy should include environmental conservation for sustainable development. An energy policy must take into consideration various means of energy – coal, oil and gas, and renewables - that can be combined to guarantee energy for all. An energy policy that does not guarantee energy for all – urban and rural dwellers, is not a good one (Ajayi & Ajanaku, 2009; Bamgbopa et al., 2019).

Due to inconsistent political will and other socio-political issues, the implementation of the policies is far below expectation in many lands. Government policy should focus on electricity and oil & gas reforms, continuous expansion of electricity capacity with the increasing percentage of renewables, expansion of local oil refining capacity, efficient management, and gas flaring eradication (Bamgbopa et al., 2019). An energy policy should also ensure there is energy security. Energy security refers to the availability of energy resources that are diverse, sustainable in quantities, affordable in prices, supports economic growth, assists in poverty alleviation, environmentally friendly, and can also take note of shocks and disruptions (Maren et al., 2013). Energy policy should ensure that it is not only one energy type that dominates a nation’s economy (Lopez et al., 2020; Middleton, 2019; Princeton University, 2017; World Energy, 2016).

A high percentage of nations’ electricity generation comes from oil and gas and their transportation system is entirely dependent on oil and gas (Energypedia,

2019; Maren et al., 2013). This means that if the oil and gas sources become depleted, then the economy will be badly affected. The government of a country like Nigeria, for example, which is endowed with both renewable and non-renewable sources of energy, should therefore develop policies that ensure a good mix of energy that will be adequate, sustainable, and affordable without over-dependence on just one type of energy source. The government should take interest in all other types of energy sources and develop them so that they can serve as alternatives to the mainstream oil and gas, such that if this source is depleted (Ajayi & Ajanaku, 2009; Ndagijimana et al., 2019), the country will still be able to meet her energy demands from the alternative sources (Maren et al., 2013).

Impact of Policies on the Production, Distribution, and Delivery of Solar Energy

The future of energy production and delivery is in solar energy because of the clean, renewable, and environmentally friendly nature (Guta, 2018; World Energy, 2016). The production and delivery of solar energy are also in line with the Paris Agreement on cleaner energy, and for the world temperature to be maintained below two degrees Celsius (Leis, 2019; Owusu & Asumadu-Sarkodie, 2016; World Energy, 2016). Hence, the governments in various countries must make deliberate policies to ensure the production and delivery of solar energy to the citizens. Such policy recommendations when considered can help reduce emissions, mitigate climate change, provide a clean environment and energy (Owusu & Asumadu-Sarkodie, 2016). The government should ensure the formulation of further policies towards the improvement of technologies in the renewable sector so that they can be sustained, and the implementation of such policies must be ensured.

The expectation is that the government and lawmakers should be able to provide an enabling environment by way of policies and regulations that will ensure the availability and adoption of solar energy technology. The government should enact policies that will ensure that the pricing of solar technology is right. This means that the government and lawmakers must intervene in enacting policies that will provide incentives for importers of technologies aiding the implementation of alternative energy. Incentives must be provided for the consumers such that they would be able to afford more sustainable cleaner energy sources that are now available (Kapoor & Dwivedi, 2020; Reddy, 2003).

Some governments and lawmakers have responded favorably by enacting policies in response to the challenges the citizens are facing in adopting solar energy technology. Such policies enacted include development and regulation of petroleum and electricity industry, fuel market policies, electricity market policies, renewable electricity policies, renewable electricity action program, energy efficiency policy, on-grid renewable energy, energy efficiency policy and strategy, rural electrification policy, Feed-in Tariff policies, Net Energy Metering, net billing law, Large Scale Solar schemes, policies on publicity on the values of renewable energy, and host of other policies that will lead to effective generation and delivery of energy to households who are the major consumers of energy in any community (Lan et al., 2020; Ley et al., 2015; Min et al., 2019).

Other policies and laws that have been enacted in some countries include tax rebates, feed-in premiums, investment rebates among other policy instruments that the government can use to drive adoption (Lopez et al., 2020). The government should also enact and implement policies that will ensure poverty reduction and education of

households as this can have a positive effect on the adoption of solar energy in some countries (Guta, 2018). Policymakers can also help by designing more robust policies on remuneration schemes to consumers by ensuring the reduction in the cost of acquisition of the solar systems and the net present value. They can also enact policies that can create stepwise changes in the design of the remuneration scheme to induce non-linear and non-intended investment behavior (Klein & Deissenroth, 2017).

Challenges of Policy Implementation

Despite efforts of the government in many countries in Africa to deliver energy to the population in an efficient manner, there have been some challenges ranging from lack of inadequate policies, corruption to budget diversion, lack of a master plan, and energy policy self-interest instead of national interest which always cause policies to be short-lived once there is a change of government.

Another limitation to the implementation of the policies is the inconsistent lack of government finances (Bamgbopa et al., 2019; Energypedia, 2019). This has resulted in what is called ‘abandoned project’ or ‘white Elephant project’ in some countries. The governments in some countries have a long way to go in other to be able to deliver solar energy projects because of this limitation.

Benefits of Solar Renewable Energy Technology

The benefits of renewable energy technology such as solar, geothermal, wind, and hydro can be classified into 3 broad categories: social, economic, and environmental.

Social Benefits

Production, installation, and use of renewable energy like solar has proved to be beneficial to the community in which the activities take place. In some

communities, the setup of solar farms has been responsible for the creation of jobs for the local people (Kumar, 2019). According to one source, more than 10 million people work in the renewable energy sector and over 500,000 jobs were created in this sector in 2017 (Folk, 2019). The renewable energy sector has created various jobs both locally and internationally in engineering, manufacturing, sales, marketing, and installations for communities where it has been implemented (Aylett, 2013; Direct Energy, 2019).

Another social benefit of renewable energy is the positive impact on the health of the people (Adenle, 2020; Guta, 2018; Kumar, 2019). Rising demand for energy because of increasing population has resulted to increasing energy prices from fossil fuels and global warming, therefore renewable and sustainable energy source like solar is a good alternative that can quickly be replenished from the sun without attendant effect on human health and the environment. Rural dwellers who used to be exposed to smokes from fossil fuels related energy sources are now replacing these with solar lanterns and bulbs thereby protecting them from pulmonary problems resulting from inhaling smokes generated by the kerosene powered lanterns (Adenle, 2020; Hamilton, 2015; Tong et al., 2015). During the COVID-19 pandemic, the government of some countries where electricity is not regular has opted for the use of solar energy to provide clean and safe electricity in the isolation centers for health workers, and for patients who in those centers are recuperating from infection by the deadly virus (Rural Electrification Agency, 2020).

The use of renewable energy technology additionally gives consumers the choice to be able to choose among several energy alternatives and settle for one that will guarantee a reduced energy bill for them. Renewable energy is a good way for

household and businesses to save money on their bills – especially in the long run, though the amount to be saved will vary based on the solar irradiation where the consumer lives (Ohunakin & Saracoglu, 2018; Renewable Energy Magazine, 2019). In many locations in the United States, installing solar panels at the rooftop has been found to result in increased property value (Renewable Energy Magazine, 2019).

Economic Benefits

The proliferation of solar energy technology has come with many direct and indirect economic benefits. Solar energy farm set-up in a particular locality utilizes local labor from the community, local material, and business, and they also use local banks (Kumar, 2019). All of these provide income for the people in the community which they use to manage their lives. For the landowners and farmers in the community whose lands have been used to establish solar farms, the solar energy installations provide an additional source of income for such property owners (Renewable Energy Magazine, 2019).

Solar energy installation and usage bring reduced energy cost (Manufacturers' Monthly, 2019; Renewable Energy Magazine, 2019). Installation of solar panels on a property allows the owner of that property to generate his electricity which can lead to reduced electricity bill (Praveen, 2014). He can also get additional income from supplying clean excess energy that has been generated to other households through the grid (Lakshmi et al., 2018; Lopez et al., 2020), or at the very worst, solar energy installations can protect against fluctuating grid electricity prices as electricity from solar practically stay the same from the commitment date. Another benefit of solar energy includes the increased property value by the homeowners especially when they want to sell the house (Farhar & Coburn, 2006; Renewable Energy Magazine, 2019).

Another economic benefit of solar energy installation and usage is energy independence. Many households adopt solar energy technology because of the benefit of being free from energy supply from the grid (Heng et al., 2020; Hernandez et al., 2014). With more investments in solar energy technology, the ability of a nation to generate energy, and meets domestic energy needs increases which leads to a reduction in the reliance on other nations for the supply of electricity (Anderson, 2014; Renewable Energy Magazine, 2019). The generation of energy from solar helps a nation to gradually move away from over-reliance on electricity from fossil fuels and increase her energy mix (Princeton University, 2017; World Energy, 2016). Solar energy production now is responsible for at least 1% of energy production of the world, and many nations are on course to ensure the generation of energy from solar takes the lead in the near future (Leis, 2019; World Energy, 2016).

Another economic benefit of solar energy technology includes the manageability of solar energy installations. After the initial installation, the household does not need to buy fuel for the maintenance, and the benefit derived from solar is not affected by changing prices of petrol, coal, or gas which makes the energy price to be stable over a long period (Gaille, 2018; Renewable Energy Magazine, 2019). Unlike petroleum, gasoline, natural gas, and other fossil fuels that are commodities produced to be bought and consumed, and therefore susceptible to natural and production factors, solar energy is a technology like any other technology, whereby the prices become cheaper as the technology is refined and the installation techniques are improved upon (Gaille, 2018). Over 20 years, the savings from electricity costs alone could be as high as $30000 for some households who have installed solar which shows that solar energy technology could be profitable in the long run (Gaille, 2018).

Environmental Benefits

One of the main reasons why many households have chosen to adopt the use of solar energy in generating electricity for the household is because of the environmental benefits (Heng et al., 2020; Kiprop et al., 2019; Ndagijimana et al., 2019; Schelly & Letzelter, 2020). One major environmental benefit of solar energy is the reduction in greenhouse emissions. The use of solar energy results in little or no generation of CO2 emissions into the atmosphere thereby leading to climate change mitigation and reduction of environmental impacts (Seibert, 2018). Because of the rising demand for energy resulting from increasing population, reliance on energy from fossil fuels could lead to an increase in global warming, hence the need for a sustainable alternative energy source that can quickly be replenished from the sun without attendant effect on the environment, solar energy is clean and very abundant in many places in the world (Adenle, 2020; Nichifor, 2015).

Major aspects of the environment are soil, air, and water. Because of the activities of man, the environments become polluted because of the discharged water from houses and industries due to excavation of hydrocarbons (Anejionu et al., 2015), polluted rain due to carbon gases from industries and generators from homes and factories, and discharge of used oils and liquids containing poisonous chemicals and heavy metals like mercury, lead, etc. But with the use of solar energy technology, a clean environment can be achieved, natural resources can be maintained, and greenhouse effect and air pollution can be mitigated by the proper usage of this renewable energy source (Kumar, 2019).

The positive effect on the living experience of the people in the community also increases the desire for solar power. In many rural communities where the grid

from the utility companies cannot be extended, the people rely on the use of coals, kerosene stoves, and lantern for lighting, cooking, and heating with its resultant effect (Guta, 2018; Tong et al., 2015; Vanadzina et al., 2019). School children struggle with pain to read their books with the kerosene lantern and are not able to read for a long time. Solar lantern, electricity and heating from solar have now replaced these traditional sources thereby saving the people from unnecessary exposures to poisonous gases from fossil fuels sources that create many health problems. Now school children can read for a longer time and enjoy their reading (AllAfrica.Com, 2020; Tong et al., 2015).

In the modern-day economy, renewable energy sources are critical to managing infrastructures required to contribute to better health for the people and many households are adopting the technology for this reason (Kumari & Kumar, 2017). Because of the instability of electricity from the grid in some locations, residents develop headaches because of the constant worry of when there would be light or otherwise but with solar, headache is relieved because of the stability and the cleanness of the electricity being supplied (Adenle, 2020; Hamilton, 2015; Rural Electrification Agency, 2020). A recent Harvard study determined that reducing greenhouse gas emissions has the potential to save public health systems between $5.7 and $200 million due to avoidance of illnesses caused by greenhouse gases (Seibert, 2018).

Drawbacks of Renewable Solar Energy Technology

Just like many things in nature, solar energy technology has some deficiencies as a source of energy generation when compared to fossil-fuel sources of energy. One major deficiency of solar energy is the high cost of installation (Deekshant, 2018;

Heng et al., 2020; Tong et al., 2015). Currently, without government subsidy, it may be impossible for households to afford the investment in solar energy because the cost of generating electricity from this source will be more expensive in the short and long run than that of generating from fossil fuel sources (Deekshant, 2018; Kiprop et al., 2019; Min et al., 2019). Thus, in lands where the government is not able to provide the required subsidy, it may be difficult for households to acquire the technology and benefit from it. A lot of subsidies and incentives from the government are also required to be able to provide solar in a commercial quantity (Green, 2020; Grimwood, 2019).

Another drawback of solar energy is in the consistency of its availability compared to other energy sources (Gaille, 2018; Wang & Economides, 2009). Nuclear, coal, and other fossil-fuel energy sources can be accessed at any time, but solar energy can only be accessed during the day when sunlight is available and mostly during summer and sunny weather conditions. This means that when there is no battery for storage, there would be no energy generated in the night and the usefulness will be limited in an environment where the system cannot be connected to the grid for energy supply at night (Anubha, 2013). Hence, it is important to invest in storage batteries in other to be able to store energy to use at the time when sunlight is not available. The storage battery may require renewals every 2-4 years and usually, the cost of the batteries could be very expensive for an average household (Eban & Hunter, 2019; Sun & Egbelakin, 2014).

Implementation of solar energy is also known to take a lot of space for the installations (Deekshant, 2018; Direct Energy, 2019). A large expanse of land is usually required for the installation of solar PV in other to generate electricity in

commercial quantity. It takes over 40 hectares of land to generate about 20 megawatts of energy (Gaille, 2018). Because of the large quantity of land required to build a solar farm and utility-scale solar energy, it makes the cost per kilowatt of electricity produced from solar to be more expensive than that of fossil fuel (Hernandez et al., 2014; Union of Concerned Scientists, 2017). Such countries like the U.S. and India having a lot of unused landmasses have great potential in generating electricity in commercial quantity using solar energy technology (Deekshant, 2018).

Looking Ahead on Solar Energy Technology

For solar energy technology to be the true energy of the future that will replace the energy from the traditional fossil fuel sources, then some of the challenges relating to its efficiency and availability must be addressed. Some authors have posited that energy in the future will be derived from sources that are completely renewable, and that space solar power has the largest potential of energy available (Grimwood, 2019; National Space Society, 2019). Sunlight found outside the earth atmosphere is 30% more intense than that found within the earth and sunlight energy reaching the earth is interrupted by clouds as a result of different weather conditions, but sunlight in the space is largely uninterrupted; hence setting up a solar farm in the space can allow more access to this energy source and the energy harvested can be beamed wirelessly via energetic microwaves to the earth (Grimwood, 2019; Snowden, 2019).

According to the National Space Society (2019), space solar power can completely solve the earth's energy problem because the solar energy available in space is billions of times greater than the totality of the energy we use in the world today. Snowden (2019) reported in Forbes magazine that space-based solar power can provide energy for everyone even in places in Northern Europe and Russia that do not

receive sunlight all year round. Many scientists believed that the space-based solution will provide an environmentally friendly answer to the world's energy problems. China, according to a source, is already planning to build the first solar power station to be positioned in the earth's orbit since the sun shines continuously in space, there is no day and night, the orbital solar power station will be an unlimited source of clean and reliable energy (Snowden, 2019).

The benefits of space-based solar energy include but not limited to environmentally friendly energy with non-emissions of greenhouse gases, the energy does not depend on scarce resources, does not produce hazardous waste which needs to be stored and guarded, it is not affected by climatic or weather conditions, it does not require mining of farmlands, it can be exported from space to anywhere in the world, and the energy can be provided in thousands of gigawatts (National Space Society, 2019) which can take care of the energy requirement of the whole world. Space-based solar does not provide an easy target to terrorists, it will provide true energy independence for countries that invest in it, it will save the world from dependence on unstable sources of energy from fossil fuels (Raja, 2017).

One of the limitations that need to be overcome is the transportation of the generated energy from space to the earth. Scientists have identified that the energy can be harnessed from space back to the earth with a powerful laser and in form of wireless microwaves, but we wait to see how this would be achieved (Grimwood, 2019; Snowden, 2019). Another limitation has to do with the overall cost of building a solar facility that will be moved to orbit from the earth, but scientists believed that the cost of not building the space solar facility is more expensive than building it which can be in trillions of dollars (National Space Society, 2019; Snowden, 2019). Other

limitation may include the size of the solar power satellite to be built which may be required to be very large in other to capture a massive quantity of energy. This is expected to be bigger than the largest spacecraft built to date - International Space Station (ISS), but the solar power satellite may be simpler because it will consist of many identical parts (Raja, 2017).

Role of Business Leaders and Governments in Adoption of Solar Energy

The adoption of solar energy has been a major issue in many countries because of the many challenges and drawbacks around the technology. The most significant of these challenges affecting the adoption of solar energy is the initial high cost of acquisition and installation (Deekshant, 2018; Heng et al., 2020; Tong et al., 2015). However, business leaders in various organizations and different geographies have enacted different business models to aid the adoption and diffusion of solar energy.

One of such business models is the financing of solar technology by some business leaders such that if a household cannot afford the full payment for the initial cost of investment of the solar energy device, he could pay a little or no deposit and pay the outstanding on an installment basis for several months (PR Newswire, 2020; Tong et al., 2015; Vanadzina et al., 2019). This is especially beneficial in rural communities where residents are poor and where electricity from the grid has not been extended because of the high cost of implementation. This business model has helped many residents in such communities to have access to solar energy technology and benefit from its many advantages.

Another business model that is a flavor of the financing model is the pay-as-you-go financing option which allows users to be making micro-payments on daily

basis using mobile money technology (Hamilton, 2015; Vanadzina et al., 2019). In some other models, the customer is expected to pay a mandatory amount as a deposit and pay the balance in form of a loan for one year at an agreed daily rate after which the system becomes theirs (Faris, 2015). Using this business model, the company ensures that users can finish payment within one year. When a user defaults in the daily payment, the company can remotely switch off access to the solar light through the embedded SIM card in the appliance. The benefit of this is that it affords many rural dwellers access to clean, reliable, and consistent off-grid electricity for as long as they continue to make their payments and after one year, the appliance becomes theirs and they do not need to make payments again to have access to light (Hamilton, 2015). This model has been profitable for the business leaders because more than 95% of the subscribers pay to avoid being cut off from the arrangement. This shows that end-user financing can be profitable for the business especially in communities where formal banking systems or mobile money technology for managing such end-user financing exist (Hamilton, 2015; Singh, 2016).

In other models, the business creates different subscription packages for customers such that the customers can choose any subscription and can move from one subscription to the other with conditions attached to it. One of such subscriptions models is for the customer to pay a non-refundable one-time fee to cover the cost that could have been paid for the entire period while another is for the household to pay a small monthly fee of a certain amount depending on the subscription they have for a period of 25years (Lg&E/Ku, 2016). There is another business model such that the customer does not have to pay any upfront payments or buy the solar system. Once a customer indicates an interest in a certain solution and enters into an agreement with

the companies, the system will be installed and then the homeowner or business will start paying less than traditional electricity utility bills (WGL Energy, 2015).

In another business model, the business leaders designed solar energy products for eligible customers who are interested in solar acquisition lease for a period of up to 20 years. The company will be responsible for the installation, operations, ownership, and maintenance of the infrastructures (Middleton, 2019). The customer receives all the KW/H output generated by the facility through a net-metering arrangement. The consumers of the energy, be it a household or a business entity, often pay little or no upfront costs and no maintenance fees (Gorevaya & Gorevoy, 2016). The arrangement gives the business and non-profit customers, including schools and local governments, other alternatives to incorporate clean, renewable energy into their energy mix through a cost-effective leasing arrangement. The company has other arrangements whereby customers can buy a minimum of two 100-kilowatt-hour (kWh) blocks of green power for a certain amount a month.

The governments in various countries have also assisted in driving the adoption of solar energy technology using different models. In New York, for example, the government is incentivizing the adoption of solar using the federal investment tax credit and this has caused the cost price of solar systems to drop significantly, and a cheaper option compared to fossil fuel-based energy sources. Other models used include offering cash incentives to offset solar cost implementation by households, reducing long term economic uncertainty of solar, improving interconnection, and net metering standards (Schelly & Letzelter, 2020).

In Louisiana, the government of the state implemented income tax credits to incentivize solar installation. The state provides a tax credit for a portion of the

purchase and installation of solar by household, and this helps to reduce the overall cost of the solar system considerably thereby making it more appealing. The residents also benefit from federal tax credits which when combine with the state tax income credits take care of as much as 80% of the cost of installation bringing the initial price of installation from $25000 down to $5000. Another model the state has used to drive adoption is the concept of net metering where homeowners who produce electricity with solar panels can save money on their electricity bills. They are allowed to sell excess electricity generated to the utility company power grid when they generate excess during sunny periods and are billed for that. At the end of the billing period, the household receives credit for the electricity produced and sent to the grid and is also charged for the amount used from the grid (Seibert, 2018).

The governments of California and Massachusetts have implemented several strategies to ensure the diffusion and adoption of solar energy technology in the states. In these states, the governments have implemented adoption strategies like solar tax credits with a cap, sales tax incentives for solar systems at the state and local government levels, property tax exemption, income tax credit with an aggregate cap, and net metering. All these incentives properly implemented have helped the cities to be among the best in terms of solar energy adoption (Seibert, 2018).

From the above review of the different business models and approaches by business leaders and governments, it is obvious that the adoption of solar energy technology requires the efforts of all stakeholders - government, business leaders, manufacturers, retailers, and marketers to ensure the diffusion. Without these efforts, many residents are unlikely to adopt solar energy even though they know it is good for the environment. According to Hai (2019), when residents are not enticed to adopt

solar energy, they tend to fall into four different categories. There is the state of activated willingness where there is self-motivation on the part of an individual based on observation or previous experience now making him to adopt solar. There is the unconditional willingness whereby the people have the willingness to adopt solar, but they are yet to start making effort to convert the willingness to adoption. There is the third group which is the conditional willingness who attaches a condition to their adoption effort. Those in this category usually posit that they are yet to have their own house and when they do, they can adopt solar. The last category is the unwillingness category who is not interested in solar though some make the commitment that they might consider this in the future.

Palm and Eriksson (2018) also posited that when no effort is made to entice and encourage residents to adopt solar energy, they tend to fall into four categories also. The non-adopters' category has access to a few pieces of information, finds the information to be complex, and then emphasizes the barriers rather than enablers. The category of environmentally engaged adopters searched for a lot of information, found the information to be too much, technical, and complicated, and drop the idea to adopt. The professionally skilled category has access to information, has problems comparing quotes, and are critical that many problems occurred during installation. The accidental adopters' category happens to get a solar system with little information and usually takes the offer from the first provider they meet.

The benefit of using the different business models by business leaders and governments is to ensure the adoption of this technology so that all sorts of challenges causing residents not to adopt solar will be dealt with. Such challenges include but not limited to an awareness of the technology, cost of acquisition and installation,

willingness to pay or not to pay for a better quality of life, consequences of adopting renewable energy technology, compatibility with social values, poor marketing and certifications of installation firms, and households' understanding of the impact of the technology on the environment (Qureshi et al., 2017; Rajagopal, 2017). Other reasons include inconvenience, personal beliefs, price concerns, economic conditions, and lack of knowledge of solar energy technology by households (Hai et al., 2017; Jayaraman & Ling, 2017).

Transition and Summary

Section 1 included the background of the problem, problem statement, purpose statement, and nature of the study. The section also included the research and interview questions, conceptual framework, operational definitions, assumptions, limitations, delimitations, and significance of the study. Section 1 concluded with a review of the professional and academic literature.

Section 2 includes the following sections: purpose statement, the role of the researcher, participants, research method and design, population and sampling, ethical research, data collection instruments, data collection technique, data organization technique, data analysis, and reliability and validity. Section 3 presents an overview of the study, a presentation of the findings, applications to professional practice, implications for social change, and recommendations for action and further study. The section concludes with researcher reflections and concluding statements.

Section 2: The Project

Section 2 contains information about the purpose and the research process for this case study. In this study, I intended to interview solar energy company business managers who cater to households and review company documents to identify strategies these business managers use to maintain a profitable business as they ensure the diffusion and adoption of solar energy technology in their localities. In this section, I also discuss the study's purpose, the role of the researcher, participants, research method and design, population and sampling, ethical research, data collection instruments, data collection technique, data organization technique, data analysis, and reliability and validity.

Purpose Statement

The purpose of this qualitative multiple case study was to explore strategies that business leaders who manage solar energy companies that cater to households in Lagos, Nigeria, use to maintain a profitable business. The targeted population was six business leaders of two solar energy companies in Lagos, Nigeria, who yielded positive returns on their investments. The profitability of solar energy businesses may lead to the proliferation of solar energy use in households, which could have a positive effect on consumers' quality of life, the environment, and the economy.

Role of the Researcher

The role of a researcher is to collect, explore, present, and interpret data in a structured manner (Cumyn et al., 2019; Karagiozis, 2018). Qualitative researchers do not use formal research methodology such as surveys, tests, or experiments to collect data (Hargis, 2020; Karagiozis, 2018). Instead, they adopt the role of the data collection instrument by conducting interviews with study participants and examining

archival data (Karagiozis, 2018; Råheim, 2016). I adopted this role while I interviewed managers at solar energy companies headquartered in Lagos. To protect the participants in this study and mitigate potential bias, I used the guidelines in the Belmont Report (U.S. Department of Health & Human Services, 1979) because the report emphasizes the importance of treating the participants and data with respect. Before beginning interviews and collecting archival data, I obtained a signed informed consent form stating that each participant was aware of my study's purpose, understood their role as participants, and was willing to participate in my study.

In my role as chief technology officer in my place of employment, I have interviewed candidates seeking employment and engaged business leaders in many companies who presented business offerings and solutions. These experiences prepared me for the qualitative interviews I conducted during this study. As part of my efforts to deliver technology that can drive and enable business in my organization, I have on several occasions reviewed solar solutions presented by vendors to verify the suitability as an alternative to the power from the utility companies. These activities have heightened my understanding of solar energy technology. I have also installed solar panels on the rooftop in my home, which has exposed me to the installation procedures, workings, and benefits of solar energy technology.

I reviewed and followed Belmont Report procedures (see U.S. Department of Health & Human Services, 1979). The report provided a guide for conducting research involving humans in an ethical manner. In line with Belmont's guidance, I communicated with prospective study participants about the purpose of my research and my research procedure. I also provided my study participants the opportunity to

ask questions, and I informed them that they could withdraw from the research at any time they deemed fit. Communicating the purpose of a research study can help prospective participants make an informed decision about whether to participate (U.S. Department of Health & Human Services, 1979).

Bias mitigation is important throughout the research process. Researchers tend to have personal and reporting biases, which can influence the interview process and the interpretation of results (Reichow et al., 2018; Saunders et al., 2015; Yin, 2018). One way to mitigate bias is to avoid backyard research, which refers to the researcher studying a site or people whom the researcher has a vested interest in. An example is when the researcher is studying their own company or department (Hull, 2017). Consequently, I did not investigate my place of employment or a relative's office for this study. I provided an opportunity for participants to read the transcriptions of the interview as well as an executive summary to make certain participant thoughts were accurately captured and rendered. This was to avoid bias and increase the reliability and validity of participants' interview data (see Houghton et al., 2013).

As part of this research methodology, I conducted one-on-one interviews with the participants. Researchers who conduct interviews one-on-one with participants often gather personal information and perspectives related to the participants and the phenomenon under study (de Kock & Hauptfleisch, 2018). I provided all study participants with an interview protocol and open-ended interview questions. Interview protocols serve as detailed guidelines for the interview process and explain the purpose of the interview and conversational guidelines. This interview protocol enables the interviewer to establish a rapport with the interviewee (Hamilton et al., 2017) and assists the interviewer to maintain a consistent approach towards the

different participants. The interview protocol also keeps the interviewer on track throughout the study (Yin, 2014). The interview protocol I used is found in Appendix A.

Participants

One important criterion of selecting participants is that participants must be selected equitably, which means that the right people who understand the phenomenon should be selected (Yin, 2018). The participants in this study consisted of six solar energy business managers who served in a leadership role in solar energy companies and who understood the phenomenon under consideration. Interviewing business managers in two solar energy companies regarding their strategies for making a profit and remaining profitable fulfilled the requirement of the research question: What strategies do business leaders of solar energy companies that cater to households use to maintain the profitability of their business?

To gain access to my study participants, I reviewed the residential solar business companies for information available online and determined who the leadership teams were, and I used this to negotiate entry into the companies, as recommended by Saunders et al. (2015). The associated guidelines of social distancing rules by the Nigeria Center for Diseases Control (2020) made gaining physical access impracticable. Also, in line with the new institutional review board rules governing the conduct of face-to-face research interview during this pandemic (Walden University, 2020), I informed my participants through the invitation mail and informed consent form that the interviews would be conducted virtually using a video conferencing tool and phone interview; hence, they needed not worry of the

likelihood of contravening established government and social guidelines at the time of the COVID-19 pandemic.

I used a sampling frame that ensured that my participants were representatives of the target population, and I did not attempt to generalize the sampling frame from one company to the other as circumstances and organization structures differ. In one company, the chief executive officer may best understand the strategy of the business while in another the chief information officer may do, and in others, business managers may be informed (Saunders et al., 2015). Data saturation refers to the point at which a researcher has gathered sufficient information and will not identify new information or themes upon conducting additional interviews (Saunders et al., 2015). Targeting the correct business leaders assisted me in obtaining data saturation after four interviews with the two companies.

To minimize technical challenges and maximize participant experience, I conducted a video test run before each interview and emailed participants a step-by-step process to assist them in attending the interviews. I ensured that my participants felt at ease with videoconferencing by thanking them for their participation and underscoring that the interviews were being conducted virtually to protect their health and mine. I chose a quiet space and recommended they did the same, to allow for clear communication and limited interruption. I conducted warmup discussions to help them feel comfortable with the process. I also followed up with a thank-you note to the participants for being adaptable and for giving up their valuable time to speak with me.

Research Method and Design

Research Method

Researchers choose among three research methodologies to carry out a scholarly study: quantitative, qualitative, and mixed. Quantitative researchers use experimental testing and statistical analysis (Saunders et al., 2015). The qualitative method supports the research aim to explore business strategies and to identify distinct trends within an organization (Crowe et al., 2011). Qualitative researchers explore topics using open-ended questions (Mohajan, 2018), whereas quantitative researchers statistically examine variables' characteristics or the relationships between two or more variables (Oberiri, 2017). Researchers conducting a mixed-method study combine qualitative and quantitative research (Almalki, 2016). This study did not require collecting and analysing quantitative data from the participants; therefore, quantitative and mixed methods research were not appropriate for this study, and a qualitative method was appropriate.

Research Design

Qualitative researchers can choose among several research design options, including case study, narrative study, ethnography, and phenomenology (Saunders et al., 2015). A single case study addresses a business phenomenon within one organization, whereas a multiple case study explores a business phenomenon within more than one company (Yin, 2018). I selected a qualitative multiple case design because I explored the business leaders' strategies for profitability in two different solar energy companies. Multiple case studies allow for comparison, especially when organization settings are different (Houghton et al., 2013). Case study researchers study one or more events, organizations, activities, or processes to gather insights

related to a phenomenon, and they generally conduct a case study in its natural context, which could be in a specific location and over a specific time frame (Houghton et al., 2013; Yin, 2018).

I also considered narrative, ethnographic, and phenomenological designs. Narrative researchers focus on the personal stories of study participants (Kourti, 2016), which did not align with the goals of this study. Ethnographic researchers study a group's culture, social world, and activities over a period of time, which was not the intent of this study (see Saunders et al., 2015). A final design consideration was phenomenology, which involves inquiring about the personal meanings of the participants' lived experiences related to a phenomenon and the recollections and interpretations of those experiences (Kaszynska, 2015), which I also concluded was not appropriate to meet the goals and objectives of this study.

In addition to selecting an appropriate research design, researchers must also ensure data saturation. Data saturation refers to the point at which a researcher has collected and analyzed sufficient information and will not identify new information or themes upon conducting additional interviews; in other words, no new understanding of the concept will come up, and further coding is no longer required (Fusch & Ness, 2015; Ran et al., 2017; Saunders et al., 2015). Data saturation is important because researchers should not draw conclusions from too few participants, and failure to reach the saturation point can hamper the validity and reliability of the result (Fusch & Ness, 2015; Ran et al., 2017).

To achieve data saturation in a case study, Guest et al. (2006) pointed out that data saturation may be attained by as little as six interviews, depending on the sample size of the population in a research study. It is however noted that studies are

different, and sample sizes required to achieve data saturation are different from one study to the other (Fusch & Ness, 2015). The researchers should be convinced that they have chosen the best sample size and quality from the population available to them that will guarantee data saturation.

I interviewed three business managers from each of the companies because I believed that these business leaders had the information to ensure data saturation. After the second interview in each company, I knew I had reached data saturation when no new theme emerged after four interviews. The third participants in the two companies echoed the information already provided in the first two interviews. After data saturation was met from interviewing the six intended participants, I realized there was no need to increase the sample size because saturation was achieved.

Population and Sampling

The population for this qualitative multiple case study was business managers of two solar energy companies operating in Lagos, Nigeria. Participants were selected through purposeful sampling. Purposeful sampling becomes very important to a researcher when only a limited number of respondents can serve as primary data sources due to the nature of the research design and objectives (Dudovskiy, 2019). Researchers who use purposeful sampling select participants based on their judgment on the best respondents who can answer the research question most effectively (Benoot et al., 2016; Dudovskiy, 2019). Using purposeful sampling, I identified company business leaders who could answer the research questions posed most effectively.

The selection criteria for the participants in this study included: (a) serving as a business leader at the case study organization and (b) having responsibility for

developing business models and strategies for the companies. These requirements met the study's focus on business leaders who discussed their strategies for making a profit and maintaining it. As mentioned earlier, I used video conferencing tools that the participants were familiar with to conduct the interviews. This enabled the study participants to choose locations of their own where they felt the confidentiality of the subject to discuss was guaranteed. Because of the physical and social distancing setting occasioned by the online interview, the respondents felt at ease to express themselves freely about the research questions for the study as noted by Oltmann (2016).

The sample size for this study consisted of three business managers each from two solar energy companies., I selected the sample size that I believed would provide adequate information required for this study. There was no need to recruit additional business leaders as data saturation was reached after the second participants. The third participants in the two companies reiterated the information already provided in the first two interviews. Data saturation refers to the point at which a researcher has gathered adequate information and may not be able to identify new themes upon engaging additional interviewees (Saunders et al., 2015).

After the completion of the virtual interviews, I conducted member checking as part of the interview protocol (see Appendix A). Member checking is a technique for validating the responses of the participants and exploring the credibility of the results (Houghton et al., 2013). This process involves writing each interview question and then writing down the interpretation of the researcher's understanding of the interviewees' responses (Birt et al., 2016; Thomas, 2016). I followed up with study

participants to validate researcher interpretations of the interview data and to gather additional insights.

Ethical Research

Ethics in research is a mandatory requirement in many nations and research institutions especially when the research is with human participants (Neves & Savago, 2019). Ethics in research covers different areas including how researchers conduct their work, how they manage the research participants, and how the results are rendered. (Pelle & Reber, 2016). I observed ethical procedures for this study by ensuring that I did not start data collection processes until I obtained permission from the Walden University institutional review board to conduct the study. After the approval of the institutional review board to proceed with the study, I applied the guidance of the Belmont Report on basic ethical procedures requiring that a researcher and the research procedures must have respect for persons meaning the opinions and choices of the research participants regarding participating in the study or not must be respected (U.S. Department of Health & Human Services, 1979).

In line with the Belmont Report, I informed all participants about the research procedures. Informing and soliciting voluntary participation from potential study participants about the research procedures can help them decide to participate in a study (U.S. Department of Health & Human Services, 1979; Yin, 2018). Since the business leaders were the target for this study, all potential participants for this study were individuals who are 18 years and older. I notified the participants before the interview through email or phone to secure their written and informed consent before setting up an interview. The consent form clarifies the boundaries of the research study to the participants and assures them of data protection as affirmed by Saunders

et al. (2015). Also, the consent form indicates that participants will receive no compensation for participating in the study and can withdraw from the study at any time, without penalties, by contacting me via phone or e-mail.

I followed the ethical procedure to protect the privacy of the individuals and organizations that participated in the research case study. Participant names have been kept confidential and their identities masked. Ensuring the confidentiality of data and assuring participants' confidentiality are ethical concerns during the research process (Saunders et al., 2015). All the participants submitted consent forms, hence, there was no need to remove references to the organization and individuals' names, demographics, or other identifiable information from the case study data. To protect their identity, I used a logical numbering sequence of the research participants, for example, participant 1 (PP1), participant 2 (PP2), and participant 3 (PP3). Also, all consent forms and case study data will be kept safe in a secure vault for 5 years both in printed form and in electronic form. After the elapse of the time, the documents – hard and soft copy - will be deleted permanently. Walden University's approval number for this study is 01-13-22-0668590.

Data Collection Instruments

Quantitative researchers use data collection instruments such as surveys and questionnaires to collect data (Lan et al., 2020; Patel & Rao, 2016). However, qualitative researchers serve as the primary data collection instruments by conducting interviews, document reviews, and observations with study participants (Canals, 2017; Elmustapha et al., 2018). I collected data for this study using semistructured interviews and company documents.

I engaged the business leaders of two solar energy companies and conducted semi-structured interviews with them. The business leaders in these companies are responsible for crafting and implementing strategies that ensure the profitability of the solar energy business in their respective companies. I started the interview engagement by asking a few *warm-up* questions and then used a semistructured interview protocol and a set of preplanned interview questions for each study participant.

Researchers use semistructured interviews to explore and analyze business topics. For example, Palm and Eriksson (2018) conducted semistructured interviews with some householders in Sweden to study the major barriers affecting the adoption of solar energy. Ambang (2019) used a semistructured interview to understand the challenges faced by health care providers in implementing National Health Plan in Papua New Guinea. Arkin and Cojocaru (2020) used semistructured interviews to investigate how adolescents that dropped out of schools in Israel view their future and whether they had an orientation towards their future. I also used semistructured interviews for data collection in this study, the interview protocol containing the interview questions is available in appendix A.

Researchers conducting qualitative studies often combine document analysis with other data collection methods to study and explore their topics. For example, Begović (2020) analyzed and reviewed historical documents while exploring strategies to address the challenges that should be addressed to ensure that sport is recognized as an activity of public interest in Montenegro. Burita (2019) also used document analysis to create an online glossary of cybersecurity as a knowledge management system in the Czech Republic.

Reliability and validity are important features in the evaluation of a measuring instrument for good research (Mohajan, 2017). Reliability refers to consistency, stability, and the ability to repeat consistent results in identical situations but under different circumstances (Mohajan, 2017). One of the ways to achieve reliability in data collection is to develop structured protocols for interview questions and recording the answers during case study engagements (Bong & Cho, 2017). I used a semistructured interview including warm-up interview questions for each study participant (see Appendix A). Another strategy to ensure reliability is to engage in data triangulation. Data triangulation allows a researcher to achieve reliability and validity by gathering data using multiples sources (Roulston, 2018). I followed this strategy by gathering my data using semi-structured interviews and company documents review.

Qualitative validity measures the degree to which the result of the research is expected to be truthful such that the research instrument correctly measured the concepts under consideration (Mohajan, 2017). I ensured validity by engaging in a multi-case study with two solar companies and collecting data using two instruments: semistructured interviews and company documents. I also ensured validity by engaging in member checking. Member checking is a technique for validating the response of the participants and exploring the credibility and validity of the results (Birt et al., 2016).

Data Collection Technique

Case study researchers use multiple data collection techniques to study a phenomenon (Williamson & Johanson, 2018). I conducted semistructured interviews with the leaders of the solar energy companies responsible for crafting strategies for

making and maintaining profit in the business and reviewed company documents. I asked the business leaders to discuss the strategies they developed and implemented to ensure the profitability of their business.

Before the interviews, I emailed informed consent forms to potential participants and requested that they complete and return before the interviews. I also followed up with phone calls to let them know that consent form has been sent to their e-mail boxes. Participants received a reminder e-mail a few days before their interviews along with instructions regarding the interview protocol, and a final reminder e-mail the morning of the interview.

Due to the COVID-19 pandemic, I did not use face-to-face interviews since this type of research was not considered an essential activity during the time. Instead, I ethically employed video conferencing following the steps in the interview protocol (see Appendix A). For example, I began the interview by introducing myself and reminding participants of the purpose of the study. I showed the participants their signed consent form and asked if they require clarifications or have any questions based on the form they signed. I let the participants know that the session would be recorded to transcribe later and then turned on the recording button on the video conferencing software we used.

Subsequently, I started with the warm-up questions and thereafter asked the interview questions as prepared and outlined in the interview protocol. I followed up with additional questions as needed. After expressing my gratitude for participating in the interview, I reminded the participants to contact me with any additional questions and thereafter discussed my plan to conduct a transcript review and a member-checking follow-up interview with the participants.

A benefit of conducting semistructured interviews as a data collection technique is that researchers can gather in-depth information about the study from the key informants who can inform the topic and subject matter experts (DeJonckheere & Vaughn, 2019). One disadvantage of semistructured interviews is that researchers spend a significant amount of time preparing for the interviews, setting up appointments, conducting the interviews, and analysing the interviews scripts. These processes can be intimidating and challenging for researchers that are unfamiliar with qualitative approaches (Adams, 2015; DeJonckheere & Vaughn, 2019). Another drawback of conducting interviews is that the process is not suited for a large number of participants but a manageable number of participants (Adams, 2015).

My second data collection technique involved the review of relevant organizational and institutional documents as recommended by Bowen (2009). I discussed access to these documents by asking each of the interviewees to suggest or provide materials relevant to the study such as materials on the organization's website, journals, advertisement, minutes of meetings, and other pertinent documents. One benefit of this data collection technique is that researchers who review company documents tend to have more insight and understanding of the research topic (Bowen, 2009; Peersman, 2014). Based on the request, company leaders can provide researchers with access to a variety of documents ranging from financial statements to minutes of meetings to program records (Peersman, 2014). For example, Stuij and Stokvis (2015) studied policy documents and reports of different interest groups to show that health-related benefits or otherwise were used at different times by various interest groups in the Netherlands to strengthen or weaken the involvement of government in sports. There are often challenges in having access to the relevant

company documents and even when physical access is granted there are other issues around gaining access to the right individuals that can be engaged for a proper understanding of the contents of some documents. (Fjellström & Guttormsen, 2016).

After data collection, I conducted transcript reviews and member checking of the data interpretations. Researchers conduct transcript reviews and member checking to ensure the reliability and validity of their data (Birt et al., 2016; Nascimento & Steinbruch, 2019). I first shared the transcribed interview data with the company business leaders who participated in the semistructured interviews to review for completeness and accuracy. Thereafter, I analyzed the transcribed information using Atlas.ti software so that I could interpret the information from participants. This process included writing down each interview question that was recorded and providing participants with a one-page summary of my interpretations (Nascimento & Steinbruch, 2019; Sutton & Austin, 2015). My interpretations of the transcribed interview were communicated to the study participants for further discussions so that they could also verify the information was accurate.

Data Organization Technique

Case study researchers must ensure that the research data and information are well organized and stored (Aczel, 2015). This is because there may be a requirement for the data to be retrieved, reviewed, and re-used in the future (Specht et al., 2018). In qualitative research, there are various ways in which information can be stored in electronic forms in computer hard disks, application databases and on the Cloud (Sage Publications, 2018; Specht et al., 2018). A researcher can use any of these available means to store data and documents for preservation, security, and easy retrieval (Saunders et al., 2015). I adhered to these requirements by creating a case study

database on a secure removable external hard drive where I store the information about the study participants and the data I collected during the interviews.

I created a spreadsheet in Microsoft Excel containing important information about my six interviewees. The important information included the names of the participants, their e-mail addresses, job titles, workplace locations, etc. in addition to whether the participants had signed the required consent documents (Saunders et al., 2015). The spreadsheet is password-protected and is stored on my laptop and in the external hard drive.

Other important documents and files are also stored and catalogued on the external hard disk storage device. These include signed consent forms, interview audio files, interview transcripts, information generated from the transcription software, and data interpretation summaries for member checking. Many researchers have used Atlas.ti software to compile, manage, and organize qualitative data (see, e.g., Riccardi et al., 2017; Schebesta, 2018). I used Atlas.ti for the same purpose in this study.

I intend to keep the external hard drive inside a fireproof safe for a minimum of 5 years, during which time only I will have access to the drive. After these 5 years, I will then delete the documents permanently. Researchers need to protect the information and data concerning the privacy of their participants and hence the need to store data securely and destroy the data after a specified timeframe (Office of the Human Research Protection Program, 2016).

Data Analysis

Data analysis refers to the process of gathering, modelling, and transforming data to highlight useful information, proposing conclusions, discussing strategies, and

making decisions (Guler, 2015). Researchers engaging in case study research are expected to ensure the credibility and validity of their study by using various methods for data collection and analysis. This is referred to as triangulation in research methodology. The process of triangulation includes using multiple methods or sources to conduct research and then comparing the results of each method to the other to ensure the accuracy and trustworthiness of the findings (Noble & Heale, 2019). For example, Johnson et al. (2017) combined exploratory interviews, documents review, paramedic accounts via audio recording, and staff focus groups to explore and identify the influence of the system in decision making in a pre-hospital setting with paramedics. Other researchers have used multiple case studies and mixed methods to collect, analyze, and test data related to a research problem (Carter et al., 2014; Heale et al., 2016). I engaged in a multiple case study by interviewing leaders in two companies about the strategies they use to ensure the profitability of their business. I also reviewed the companies' documents related to this topic to get additional information and facts that will ensure the credibility of my study.

Many case study researchers have followed the five-step process for qualitative data analysis proposed by Yin (2015) which includes compiling the database, disassembling data, reassembling data, interpreting data, and concluding the analysis. Following this process ensures that the researcher observes, gathers, and presents honest data and information that will enrich the outcome of the study (Durodola et al., 2017). For this study, I compiled company documents, and interview transcripts. Member-checking data confirmed accuracy during follow-up interviews. Member checking includes validating the response of the participants to further

explore the credibility and validity of the data collected and to gain additional insights (Birt et al., 2016; Thomas, 2016).

After compiling the data, I transferred all data into Microsoft Word and manually disassembled, reassembled, and analyzed the data to identify key themes. I then transferred the data into Atlas.ti data analysis software for computer-aided disassembling, reassembling, coding, interpretation, and theme development. Data analysis software like Atlas.ti and NVivo, are used to compile, manage, and organize qualitative data (see, e.g., Min et al., 2017; Riccardi et al., 2017; Wilk et al., 2019).

After using Atlas. ti software to run the analysis, I then compared the themes generated by the software with the ones I generated manually and then compared the results for accuracy and consistencies. The objective of qualitative data analysis is to identify common themes that answer the central research question (Yin, 2015). The focus of the themes in this study was the strategies that business leaders use to make a profit and remain profitable in the solar energy business. I verified the common themes, and compared, contrasted, and connected these themes with the key profitability of the solar energy business themes from the literature review.

I used the conceptual framework in the study as a foundation throughout this study for analyzing data, interpreting data, and developing themes. The framework for the study was the diffusion of innovation theory. I explored strategies used to maintain the profitability of resident solar energy businesses using the diffusion of innovation theory to identify common themes based on this theory.

Reliability and Validity

Researchers are required to ensure the quality of their study by ensuring the reliability and validity using the appropriate data collection methods and analysis

(Gog, 2015). For example, researchers must show qualitative reliability, which describes consistency in gathering data within the employed analytical procedure (Leung, 2015; Noble & Smith, 2015). Qualitative researchers must also integrate qualitative validity checks into their research to strengthen the trustworthiness, credibility, accuracy, and truthfulness of the research findings (Brigitte, 2017). The concept of reliability and validity is also very important to quantitative researchers as they must ensure the consistency and accuracy of scientific findings which are expected to be applied to solve real life problems (Brigitte, 2017; FitzPatrick, 2019). Qualitative researchers typically use four quality criteria to confirm that their study is reliable and valid. These are dependability, credibility, transferability, and confirmability (Forero et al., 2018; Saunders et al., 2015).

Dependability

This process ensures that the findings of the research are repeatable if a similar cohort of participants is engaged with the same set of inquiries (Forero et al., 2018). To achieve dependability, qualitative researchers should ensure that the research process is logical, traceable, and well documented in case the research findings are to be reviewed by other researchers in the future (Forero et al., 2018; Nowell et al., 2017; Saunders et al., 2015). I exhibited dependability in this study by keeping records of the raw data, the field notes, and transcripts for reviews and ensured that I did member checking to validate my data interpretations. Member checking allows the researcher to establish a match between respondents' views during the interview and the researchers' representation of the interview responses (Nowell et al., 2017; Thomas, 2016). After transcribing all semi-structured interviews verbatim, I provided transcripts to the interviewees for review to ensure that I have captured the

information accurately. I then further reviewed the transcripts, wrote short interpretations for each interview responses, and shared a copy of the interpretation summaries with study participants to revalidate during a follow-up interview.

Credibility

I ensured I maintained credibility by conducting member checking with my study participants. Researchers who conduct member checking offer study participants an opportunity to confirm the researchers' interpretations of the interview data (Birt et al., 2016; Thomas, 2016). I also ensured data triangulation. Data triangulation allows the researcher to achieve credibility by gathering data from multiple sources (Noble & Heale, 2019; Roulston, 2018). Sources in this study included semistructured interviews with company leaders and a review of relevant company documents.

Transferability

This study addressed the transferability related to future research on the profitability of the solar energy technology business. Transferability is different from generalizability, which is a crucial criterion for evaluating the rigor of quantitative research, and a process where quantitative researchers using statistical generalization extrapolate findings and conclusions from a small sample to a population (Polit & Beck, 2010). Quantitative researchers try to make broad claims about their findings, on the other hand, qualitative researchers tend to focus on one subject or group and thus may not generalize a study's results to larger populations. Qualitative researchers can also offer transferability by providing in-depth understanding and meanings of a phenomenon thereby helping the readers to understand how a study's findings might relate to their own experiences (Carminati, 2018; Leung, 2015).

One way to make the results of a qualitative research study transferable to readers is to provide as much detail as possible about the time, place, people, and other social contexts where the case study research occurs (Leung, 2015). In Section 3 of this doctoral study, I will provide detailed descriptions about the companies' size and locations, study participants, the locations of the interviews, and the research methods for the study. When case study researchers provide specifics about their research environment and study participants, readers can determine whether the results apply to their workplaces (Carminati, 2018; Leung, 2015). Providing well-documented details about a study can help researchers who might want to conduct a similar study in the future (Forero et al., 2018; Nowell et al., 2017). However, if researchers decide to carry out a case study research similar to this study, they can anticipate different results if they plan to use a different industry, a larger institution, or different data collection methods.

Confirmability

This refers to the establishment of a relationship between the research interpretations and findings, and the data used for the research (Nowell et al., 2017). The researcher must demonstrate clearly that conclusions and findings have been derived using the interview data. I used a structured interview protocol to ask questions, and I recorded responses during the semistructured interviews with my participants (see Appendix A). I also ensured that the information and data gathered were well transcribed and detailed notes kept aiding my review towards ensuring appropriate research findings and conclusions that guaranteed confirmability in this study. Researchers use interview protocols to guide their conversations and establish a

good rapport with the study participants which helps researchers remain objective as they ask questions and gather data (Hamilton et al., 2017).

Data Saturation

This refers to the point at which a researcher has collected and analyzed sufficient information and will not identify any new or additional information upon conducting additional interviews with the participants (Ran et al., 2017; Saunders et al., 2015). Researchers can achieve data saturation by selecting the appropriate sample size and the right sample population (Fusch & Ness, 2015). One way that I ensured I achieved data saturation was by engaging the senior people in the companies who understood the profitability strategy of the business and were able to provide quality information than other persons in the company. I suspected I had reached data saturation after the second interview because the third participants in both companies only echoed the strategies the previous participants had earlier mentioned.

Transition and Summary

Section 2 contained the purpose statement, the role of the researcher, an overview of the participants, the research methodology, and design for the study. Furthermore, section 2 presented the population and sampling method, ethical research, data collection instruments and technique, data organization technique, and data analysis. The section concluded with a discussion of qualitative reliability and validity.

Section 3 begins with an overview of the study and a presentation of the findings. The section also contains narratives on applications to professional practice, implications for social change, and recommendations for action and further study. Section 3 concludes with the researcher’s reflections.

Section 3: Application to Professional Practice and Implications for Change

Introduction

The purpose of this qualitative multiple case study was to explore strategies business leaders who manage solar energy companies catering to households in Lagos, Nigeria, use to maintain a profitable business. The diffusion of innovation theory introduced by Rogers (2003) was the conceptual framework guiding this study. Six leaders from two solar energy companies participated in the study. Participants indicated several strategies implemented that contributed to the profitability of the solar energy business. These included aggressive marketing, advertisements, awareness creation through online and various social media platforms, and financing options. Others included after-sales maintenance, support, online monitoring of systems, product differentiation, and rural electrification projects.

Presentation of the Findings

In this qualitative multiple case study, I sought to answer the central research question: What strategies do business leaders of solar energy companies that cater to households use to maintain the profitability of their business? To answer this question, following the directive of Walden University regarding the COVID-19 pandemic, I conducted virtual interviews using Zoom video conferencing facility with six leaders of two solar energy companies, A and B (pseudonyms) headquartered in Lagos. I also reviewed relevant company documentation. A was a midsized solar energy company with between 200 and 500 employees while B company was a smaller solar energy company with approximately 50 employees. Both A and B had their headquarters in Lagos, Nigeria, with branches, distributors, and agents all over the country.

Three leaders in each of the companies received invitations to participate in the study. The criteria for selecting the participants included individuals who have worked for the companies in senior positions and who understood the strategies of the companies and participated in implementing these strategies. All six people who received invitations to participate from the two companies eventually participated despite the difficulty securing appointments due to their busy schedules. All the participants worked at the headquarters of the companies in Lagos. Study participants' positions ranged from senior sales analyst to business manager to vice president. I achieved data saturation after the second interview in each company as no new information was forthcoming. Data saturation refers to the point at which a researcher has gathered sufficient information and is unlikely to identify new information or themes upon conducting additional interviews (Saunders et al., 2015).

I conducted and recorded, with permission, the virtual semistructured interviews using Zoom video conferencing facility. The six participants responded to the seven open-ended interview questions listed in an interview protocol (see Appendix A). Interviews were between 20 and 45 minutes. During the interviews, participants shared perspectives, personal experiences, and insights from their workplace regarding the strategies they use to achieve the profitability of their solar energy business. Throughout this process, I referred to all participants using separate aliases, such as PP1of Company A, PP1of Company B, and so forth.

After each interview, I thanked the participants for their involvement in the study. I then transcribed the recorded interviews and sent the transcripts to the participants to review for accuracy at the earliest. I followed up with calls when I needed clarification. I conducted member-checking with the participants using emails

and telephone calls. The member-checking process involved providing participants with one-page interpretations for each of their responses to the interview questions. The purpose was to confirm that my interpretations were accurate and representative of the strategies they use as companies. This process also provided participants with an opportunity to share additional information about the research topic, which further enabled me to achieve data saturation.

Case study research includes the use of data triangulation, which involves gathering data from multiple sources (Noble & Heale, 2019; Roulston, 2018). Examples include interviews, participant observations, company documentation, and online information (Yin, 2014). I corroborated the data I collected during the virtual semistructured interviews from the participants by reviewing company documents. The documents included the company website, social media, and PDF documents provided by the participants on company activities.

After completing the data collection process, I followed Yin's (2014) 5-step process for qualitative data analysis that included compiling, disassembling, reassembling, interpreting, and concluding. I started this process by transferring the interview data into a Microsoft Word document, and I manually coded and analyzed the data to identify key themes. I then transferred the data into the Atlas.ti version 9 qualitative analysis software program for computer-aided coding, interpretation, and theme development.

I compared the themes emanating from the manual analysis and the computer-aided processes. I identified four themes from the interview and company documents: (a) create awareness for solar using personal selling, social media, and online/digital channels; (b) offer attractive financing options; (c) participate in rural electrification

projects targeted at low-income household and with product variations; and (d) partner with distributors and agents and provide after-sales support. All four themes confirmed common themes from the literature review for this study. Table 1 contains a summary of the themes that evolved and the number of participant responses.

Table 1

Coding of Participants' Responses Related to Themes

Themes	Participants[a]	Responses[b]
1. Create awareness	6	35
2. Offer financing options	6	17
3. Participate in rural electrification	6	10
4. Partner with distributors and agents	6	31
Total (duplicated)	24	93

Note. [a] Number of company leaders who provided responses linked to the themes. [b] Number of interview questions for which participant responses linked to the themes.

All the participants' feedback reinforced Rogers's (2004) characteristics of diffusion of innovation theory: (a) relative advantage, (b) compatibility, (c) complexity, (d) trialability, and (e) observability. All six participants mentioned that the products offered by their companies have one advantage or the other over what the targeted households currently have, and these solutions are compatible with their needs. The participants also indicated that the solar home solutions (SHS) offerings are not complex but very easy to use, even for the low-class people in the rural areas. PP2 of Company A confirmed that sometimes they give out some of these products to the leaders in the rural areas to try out, and once they confirm that the functionalities meet their needs, they then call others in the community to come and observe. This has helped in the adoption of solar solutions in these communities. Participants indicated that when households believe solar solutions are working, can see around,

are affordable, and are compatible with their needs, the adoption rate increases, with a positive impact on profitability.

Theme 1: Create Awareness for Solar Using Personal Selling, Social Media, and Other Online and Digital Channels

All participants noted that companies who create awareness of their product offerings to the public by way of face-to-face marketing to potential customers, social media, and other online channels get more adoption of solar solutions (see Table 1). Business leaders must develop different marketing strategies that will ensure that all audiences are reached. The suppliers, vendors, and government must work together collectively to enhance campaigns to create awareness to the public regarding solar solutions benefits (Palm & Erksson, 2018; Qureshi et al., 2017). The study results show that company leaders who include consistent awareness creation as part of their business strategies increase the adoption of the SHS. This results in an increase in sales and positively impacts the profitability.

All the participants revealed that awareness creation is an important precursor in creating a strategy to increase the adoption and profitability of the solar energy business. PP1 of Company A mentioned that “the best strategy we have used to create awareness is through social media,” and this has helped the company to improve the adoption of solar and the profitability of the business. Company A has been able to push awareness to many people through social media platforms like Facebook, WhatsApp, Instagram, and LinkedIn. PP1 also mentioned the use of radio jingles as another way the company has created awareness. PP2 of Company A mentioned another way the company has been able to reach a larger audience: “The company

sends sales representatives to different rural communities to educate them about solar energy and the benefits they can derive from the solutions".

PP3 of Company A added, "we run campaigns, we have yearly, monthly campaigns that we run for our categories of businesses, we reach out to customers through advertisement on social media, we also reach out to them through our campaign initiatives." PP1 of Company A earlier mentioned that their company business leaders use the strategy of running campaigns from time to time, and some of these campaigns have boosted the sales of the SHS, which in turn has affected profitability positively. PP1 of Company B reiterated the importance of end-user education and awareness creation. One of the ways the company of PP1 Company B has created awareness and education is through regular webinars meant for different audiences – partners, distributors, and end-users (household). There are also articles and white papers provided on the company website for the customers and potential customers to read for their education.

PP2 Company B reiterated what most of the participants mentioned regarding advertisement through social media and radio jingles. He however further added:" As part of our strategy for profitability, we sponsor events where we know a lot of people will attend and use the opportunity to get 10-15 minutes of talk time to address the audience about the company, the benefits of solar home solutions, and the various solar solutions they have for the end-users to adopt." He also mentioned that they leverage the financing partners' platform to share information that customers can get to educate themselves. PP3 of Company B reiterated what other participants said regarding social media and online/digital channel advertisements.

The two companies' documentation reviewed confirmed that the companies have home solutions designed for end-users and have used various means to create awareness. These include campaigns, workshops, events, and exhibitions to showcase the solutions and the benefits of these solutions to the end-users. The companies' websites also showcase the products and the benefits of solar solutions to customers and potential customers alike.

These findings corroborate the literature on factors responsible for solar adoption at the household level. Leaders of companies who want the adoption of their products must ensure public awareness and knowledge of that product through effective marketing of the products by the marketing team not only to the urban locations but also the rural areas and by using every available media (Jayaraman & Ling, 2017; Katikiro, 2016). Qureshi et al. (2017) posited that one of the ways companies can increase awareness is by engaging in campaigns so that the public and end-users can become aware of the different home solutions available and thereafter make a move towards adoption. PP1 and PP3 of Company A in their responses mentioned marketing campaigns as one way the company created awareness of the home solutions they have. PP3 especially mentioned campaigns like ”one Nigeria child, one solar light”, and “energy out of poverty,” specially designed for people in rural areas so that they can understand what solar energy solutions are and the benefits they can reap from them. These campaigns have led to more customers in the rural areas adopting the solutions and increased profitability.

Theme 2: Offer Attractive Financing Options

Participants noted that more households have been able to adopt SHS when the companies make available financing options (see Table 1). Most households feel

that solar solutions are too expensive and hence not affordable for them (Katikiro, 2016; Deekshant, 2018). Business leaders must craft strategies and business models that provide financing options that will enable as many people as possible to adopt the variety of SHS designed for them (Hamilton, 2015; Vanadzina et al., 2019). All six participants emphasized that the initial cost of acquisition of solar energy can drive away households hence the need for financing options as a major strategy to make solar solutions affordable for the end-users.

Participants 1, 2, and 3 of company A mentioned the financing options that the company has used as a major strategy to ensure that households can adopt their home solutions. PP2 of company A mentioned that "we have the flexible prepayment plans where customers can decide what they want to be paying per month on the payment form and can be for 5 years, 2 years or less depending on the capacity of the customer. Another that we use is Pay-Go which allows customers to buy a solar product of their choice and pay within a maximum period of 2 years after which the product's ownership is transferred to the customer." This is also called pay to own which is normally applied to the people in the rural areas. PP2 company A also mentioned the use of technology to monitor compliance so that some crafty users will not sabotage the effort and avoid payments. Participants 1 and 3 of company A mentioned other financing options such that the customer buys a SHS, pay a bulk amount of his choice, and spread the balance over 6 months to 1 year. Customers can also buy SHS of their choice and signs an agreement to pay for 5 years without any initial payment. Participants 1 and 3 of company A mentioned the availability of credit loans for households and small businesses that the company offers so that

customers who cannot afford the outright payment can still buy the SHS of their choice and in line with their financial capacity.

Participants 1, 2, and 3 of company B also emphasized that one of the most important strategies of the company is to provide a financing option for the customers because they realize that it may be difficult for customers, especially households with low income to be able to buy outrightly. PP1 of company B said that "what we have done is that if a customer cannot afford to buy or acquire the system outrightly, we have a business model call 'lease to own' which is the flexible payment agreement that enables our customers to pay over specified payment tenor – we have 12 months, 36 months, 60 months." PP2 of company B added " we have come up with a lease to own option for up to 5 years where you can pay and if we are not sure of what we are giving you we won't ask you to pay for up to 5 years and this has helped us to record significant success." PP3 of company B corroborated this point when he mentioned that " one of the most important strategies that we have used is our flexible payment system." He also added, " so one of the strategies we have developed is to have a flexible payment which we call the lease-to-own". All the three participants mentioned that the company has a lease-to-own financing option whereby customers can buy their solutions and make payments over a period. This, they confirmed has resulted in the increase in the adoption of their solutions by customers, sales growth, and profitability of the business.

The documents from the companies also emphasized this theme. For example, company documentation shared by participants 1 and 2 of company A confirmed that the company has financing options for the customers clearly stated on these documents. The website of company A also has information concerning the financing

options that the company offers to their customers who intend to own an SHS. The document shared by PP3 of company B verified the information provided by all participants of this company on the major financing option which is a lease to own provided by the company to the customers so that the initial cost of acquisition will not be a limiting factor for them in adopting solar energy. Company B's website also corroborated the fact that the company offers a lease-to-own financing option for their customers. This strategy on financing options on the part of the two companies attracted more customers to adopt solar energy and positively impacted the profitability of the companies.

This emphasis on financing options confirms key themes from the literature review. Multiple researchers indicated that business leaders who enact business models that provide customers with financing options apart from outright purchase can get more people to adopt the solutions, save them the stress of the initial high cost, and installation of the panels (Deekshant, 2018; Hamilton, 2015; Heng et al., 2020). When business leaders implement good business models and strategies that involve the use of appropriate financing options and technology to manage payment compliance, these proved to be profitable for the business, beneficial for the community and the environment. (Hamilton, 2015; Singh, 2016).

Theme 3: Participate in Rural Electrification Project Targeted at Low Income Households and Product Diversification

In many parts of Africa and some parts of Asia, many people, especially those who live in the rural communities are generally low-income and do not have access to the electricity from the grid because of the high cost of grid extension to these locations (Ndagijimana et al., 2019; Wakeford, 2018;). Hence, people in these

communities must cope with the daily challenges of using energy sources from fossil fuels for lighting, cooking, and heating with its resultant effect (Guta, 2018; Vanadzina et al., 2019). School children struggle with pain to read their books with kerosene lanterns and cannot read for a long time talk less of enjoying their reading (Tong et al., 2015). Some company leaders have crafted strategies to provide solutions to these problems using solar. These have not only driven the adoption of solar energy solutions but have also provided an excellent return on investments for the business.

Rural Electrification

Business leaders who wanted to be profitable in the business of solar energy have seen opportunities in the electricity needs of the rural areas. And as such, they have crafted strategies around ensuring that different solar energy solutions like off-grid, mini-grid, and scalable SHS are designed and made available to rural communities (Antonanzas-Torres et al., 2021). These solutions have helped increase the adoption rate of solar systems and the profitability of the solar energy business.

Participant 1 of company A mentioned that the company has engaged in various rural electrification projects in several communities which have brought electricity to these locations. He reported that “we have a big governmental project ongoing now call Rural Electrification Agency, we are the one supplying households’ solar systems, so far we have supplied over 50,000 to 100,000 systems to homes and households”. These projects have further reinforced the belief in solar solutions in the people and has resulted in an increased adoption rate. Participant 1 of company A also added that “We are currently handling mini-grids projects in the South-South, South-East, and South-West and these are interesting results that are strong to show that our

strategies are working". This has impacted the profitability of the company positively. PP2 of company A affirmed that participating in rural electrification projects has helped the company so much in creating innovative solutions that cater to the basic needs of the people like lighting, charging phones, and listening to radios. He also confirmed that this strategy has increased the bottom line of the company in terms of profitability.

PP3 of company A reiterated the importance of the strategy to reach out to the rural communities to the company. In one of the outreaches to the rural communities that use firewood to provide lightings and heating daily, over a thousand pieces of portable SHS were sold to provide electricity to power light, fan, radio, TV, and charge their phones. These, according to PP3 of company A, have led to increased adoption of solar energy, increased sales, and increased profitability of the solar energy business. PP3 of company B also mentioned that the company is one of the solar energy companies that have partnered with the Federal Government of Nigeria in the rural electrification projects. He said, "we have some form of partnership with the federal government and in the recently announced solar power Naija – that is Nigeria electrification project, we are one of the partners to the federal government on this project". These, according to PP3 of company B are meant to ensure that more people have access to electricity and that 30% of the energy mix is from solar by 2030.

Product Diversification

One way in which the solar energy business leaders have ensured the rural electrification movement is through product diversification, using a variety of SHS (AllAfrica.com, 2015; News Bureau, 2019). Business leaders have now created solar

solutions for industrial, commercial, households including high-income earners, middle-income earners, low-income earners, and rural dwellers (AllAfrica.com, 2015). Participants 1 and 2 of company A mentioned that the company has created products that suit all individuals, including high class, middle-class, and low-class. This made it easy for the company to reach out to rural areas where there are mostly low-class people since there are product categories designed for them to meet their needs.

PP2 of company A emphasized that the company has been able to tackle the solar energy needs in the country by designing different solutions for different categories of people in such a way that the solution will be commensurate with their income and needs. He said, “one of the things we did as a company was that we have different designs to tackle different problems according to their needs. We have a design for low income, we have for the middle class, we have for those in the upper sector or income of the society. This has really helped because we want our products to be available everywhere and affordable.” He also mentioned that the solutions are upgradeable such that if the needs and the income level of a household increases then they can upgrade to the next product category. PP3 of company A also reiterated the fact the company has a wide range of products to meet the energy needs of different categories of people. All the three participants in company A admitted that this strategy has helped increase sales, the adoption of solar energy products, and the profitability of the business.

Participants 1, 2, and 3 of company B confirmed that the company has different products that are available for the customers. PP2 mentioned that products can be built to the specifications of the customer upon request. Company documents

reinforced the comments of the participants. For example, the company documents shared by the participants in company A show that the company has engaged in several rural electrification projects with many SHS made available to households in rural areas to meet their basic electricity needs. Company websites for the two companies also revealed that they have a variety of products for households, small businesses, and corporate companies.

This strategy of participating in rural electrification projects and product variety confirms key themes from the literature review. Multiple researchers reiterated that one of the best ways to ensure the adoption of solar energy is to target the people who do not have electricity currently because the grid electricity has not been extended to them. The record has it that over 77 million Nigerians were without power as of 2019 and with over 85% living in rural areas (Antonanzas-Torres et al., 2021; Ndagijimana et al., 2019). This implies that any strategy targeted at providing rural electrification and a variety of products that are affordable for these low-income populations will lead to increased adoption of solar energy and a more profitable venture for the business.

Theme 4: Partner With Distributors and Agents and Provide After Sales Support

Study participants indicated that their companies could reach more end-users when they partner with salesmen, distributors, and agents. Companies that use salesmen, sales agents, and distributors have been known to reach more household audiences to adopt solar energy, and the companies have been able to increase the profitability of their business (Alsever, 2015; Jinko Solar, 2015; Kratschmann & Dütschke, 2021). Solar energy companies that provide after-sales support and

maintenances have been known to be able to increase household adoptions in the communities which in turn have positive impacts on the companies' sales and profitability (Karakaya & Sriwannawit, 2015; Kebede et al., 2014; Lo et al., 2018). Study participants explained that when their companies' partner with distributors, financial organizations, sales agents, and provide after-sales support and maintenances, sales volume increase as well as profitability.

Partnering With Distributors and Agents

PP1 of company A identified partnering with franchise agents and distributors as strategies that have helped the profitability as these distributors and agents help spread the home solutions from the company to other locations. He mentioned: "We offer our services and also sell products to other businesses which we call franchise partners who are like major distributors". PP2 of company A also mentioned that the company uses agents to market SHS to the rural communities where there are low-income households which have turned to be more profitable for the company. He also mentioned that the company, knowing the benefit of these agents and partners, provide the necessary training for them to aid them in marketing the products to households. PP3 of company A reiterated that the company uses partnership channels to come in and buy their products at a wholesale price and then sell at retail price to their customers. He also mentioned that even staff can become franchise partners and start marketing the products to potential customers. All these efforts have impacted the profitability of the business positively.

PP1 of company B identified "leveraging working with partners" and "collaboration with other players in the solar energy space that can buy directly from us as partners, system integrators, distributors" as one of the key strategies of the

company that has helped them to maintain profitability and be able to reach more end-users to adopt solar energy. PP2 of company B confirmed this strategy of partnering with distributors by mentioning that the company sells majorly through dealers that already have footprints in the six geo-political zones of the country. He mentioned that the company's strategy is to leverage the presence of dealers and this way the products from the company diffused quickly to the end-users. He also mentioned that the company is focusing on financial partners because they already have an existing customer base numbering millions to sell their products. He confirmed that this strategy is cost-effective for the company and has proved to be profitable. These two participants from company B confirmed the effectiveness of using partners and distributors to increase the adoption rate of SHS by the end-users and the attendant profitability this has brought to the company.

After Sales Support

Most participants alluded that after-sales support is a good strategy that has helped build trust and confidence in the companies, and this has been responsible for doubters in SHS to take the risk of adoption since they know their appliances will be taken care of in case of any fault. PP1 of company A referred to after-sales support as a vital strategy that has helped increase the trust in the company's product as well as sales volume since the customers are aware that the company will provide the necessary support for faults during delivery or usage of the appliances. PP2 of company A emphasized that after-sales service has been a key force in helping the company to get partners and customers confidence that they can do business with them. He stated “once I take the customers on a tour of our after-sales service and maintenance, they are convinced. That has been a strong selling point for us because

most of the people in this industry do not have this kind of setting. We have been able to gain customer's confidence". This has helped the adoption of the solar home products of the company and impacts profitability positively. PP3 of company A highlighted how the company goes about after-sales support by calling on customers after 3 months to confirm if products are functioning well or not and they also have a team of technicians going about checking on people they have sold the solar home products to. An outlier emerged from this research data as highlighted by participant 3 of company A that the company could have been more effective in providing after-sales support if the replaceable parts are always in stock as he noted that sometimes the parts to fix a fault on an appliance are not in stock and are not re-stocked by their management as quickly as required.

PP2 of company B emphasized the use of online monitoring tools as what the company is using for after-sales support. He mentioned, "So what we do and is unique to our products is that there is an online monitoring system that helps us to monitor the customer's usage and consumption, it is online real-time, we are able to know when your system is at fault, so we do a lot of preventive maintenance rather than corrective maintenance". With this tool, they can do preventive maintenances of their appliances before they developed a fault. He stated that this has helped the company save costs and be more profitable when compared to other players in the industry. PP3 of company B also elucidated that after-sales support has helped the company maintain its customer-first approach, and customers are now marketing the products to other customers based on the service experience from their company. Regarding the after-sales support, over 80% of the participants confirmed that after-sales support is an important tool in ensuring the adoption of solar home products and the

profitability of the solar energy business. Company documents shared by participants also confirmed that after-sales support is a key strategy of the companies to ensure adoption of the various products, appliances, and home solutions and to ensure profitability. These findings confirmed earlier research mentioned from literature review regarding the effect of the use of partners and distributors; and the importance of after-sales support in driving adoption of solar energy products and profitability of the solar energy business (Karakaya & Sriwannawit, 2015; Kebede et al., 2014; Kratschmann & Dütschke, 2021; Lo et al., 2018).

Findings Related to the Conceptual Framework

I used Rogers's (2003) theory on diffusion of innovation to explore the strategy that business leaders in solar energy companies use to ensure and maintain the profitability of the business. Based on this theory, innovation can only spread among people within a social system if it has the following characteristics: (a) relative advantage, (b) compatibility, (c) complexity, (d) trialability, and (e) observability (Rogers, 2004). When a product exhibits superiority and offers additional financial value above existing products, then the households are likely to adopt such products (Elmustapha et al., 2018). When the innovation is consistent with households' experience and social values, the rate of adoption is likely to increase (Elmustapha et al., 2018; Reyes-Mercado & Rajagopal, 2017). When the new product is easier to use and less complex when compared to an existing product, the rate of adoption will jump up (Kapoor & Dwivedi, 2020). Hayes et al. (2015) also indicated that when households can test new products for a limited period before making a financial commitment, the rate of adoption tends to increase. Also, when the households can see the values of innovation around them, this increases the acceptance and the

adoption rate by households. The companies continue to create awareness on the relative advantage of solar energy solutions to households and other potential customers using various means.

Study participants corroborated the diffusion of innovation theory. All the study participants from the two companies in this study expressed that SHS are better than the darkness people in the rural areas experience. Also, the consistency and reliability are better than unstable electricity from the grid experienced by people in the urban areas in the country. In addition, all the participants confirmed that the financial cost, in the long run, is cheaper than the cost of buying a generator, diesel, petrol, and the cost of maintenance of such power generating machine in the long run. Also, because of the power situation in the country, solar energy solutions are quite consistent with the expectations and values of the households. All the study participants in both companies confirmed that the companies produce different types of products that will meet the needs of the different category of individuals – low, middle, upper class, and rural households as such the products are not complex for use by the different categories.

Participants 1 and 2 of companies A and B retorted that everybody needs light – stable and consistent electricity. This is not the experience right now, but solar energy has the consistency and reliability which is in line with the expectations of the household. PP2, company B related that to get the rural households to adopt, sometimes they give some of the solutions to the community leaders to try to use so that others in the community can observe. Once they see that the solution works, it makes their adoption decision very easy. Participants 1, 2, and 3 of company A also mentioned the installation of streetlights using solar panels in various communities.

Households in these communities can easily observe if solar works or not and based on this can make their adoption decision. PP3 of company B also mentioned that the company uses previous installations in different communities as reference points for potential customers to observe and be convinced of solar solutions adoption. The two companies in the study have responded to this Rogers (2003) theory of innovation by crafting strategies that address the characteristics of diffusion of innovation to the household and the results of this have been an increase in sales volume and increase in profitability of their businesses.

Applications to Professional Practice

The specific business problem for this study was that some business leaders who manage solar energy companies catering to households lack strategies to maintain a profitable business. The findings from this study could be of value to business leaders of solar energy companies who are unable to make a profit while catering to the customers. The findings can be applied to advancing business practice because they include specific suggestions for increasing the adoption of solar energy solutions by households, sales growth, and profitability.

Based on the participants' responses to the semistructured interview questions and the review of company documents, I found that for leaders to improve business practice, they should consider creating awareness about solar energy as a better alternative to unstable and inconsistent electricity from the grid. These, they can do using face-to-face marketing, campaigns, webinars, social media platforms, online and digital platforms, exhibitions, and events. Other suggestions included using a variety of financing options to encourage households who may not have the financial capacity to purchase the solutions outrightly. These financial options include pay-as-

you-go, lease-to-own, instalment payment, and staggered payment. Other important recommendations included targeting the low-income households in the rural areas who do not have electricity because of the inability of the government to extend the grid to the locations. These households will adopt the SHS because they are simple to use and are better than the darkness that they are hitherto experiencing. Also, the ease of payment made available by the companies is another attraction.

The product variations came up as an additional suggestion that aided the adoption of solar energy solutions and the profitability of the business in rural areas. There are variety of products for low, middle, and high-income such that households can make choices based on their current financial capabilities and can upgrade later if the family economy improves. Additional recommendations included partnering with distributors and agents to reach more households and other potential customers. These distributors many times can reach out to more households using their existing networks than what the companies can do. Another suggestion is that solar energy companies should provide comfort for the household regarding the availability of technical support and maintenance in case they experience any issue with the appliances. Information about this should be made available using all available means of reaching out to potential customers as this can enhance the adoption decisions of households.

These findings are relevant to improved business practice as they represent strategies that other researchers, including, Hamilton (2015), Yadav et al. (2019), Vanadzina et al. (2019) who noted that having the appropriate financing options can improve the adoption decisions of the households which in turn leads to the profitability of the business. Multiple researchers posited that when there is awareness

about solar energy products and the households know the choices available and at what cost, it tends to increase the adoption decision (Jayaraman & Ling, 2017; Palm & Erksson, 2018; Qureshi et al., 2017). When solar energy companies use distributors and agents combined with appropriate finance options, the adoption rate by potential buyers has been found to increase (Alsever, 2015; Amiraly & Sawamura, 2016; Kratschmann & Dütschke, 2021; Lo et al., 2018). Additionally, Gorevaya & Gorevoy (2016) and Antonanzas-Torres et al. (2021) posited that when companies engage in rural electrification projects, they can reach out to more households who buy the different home solutions based on their income level and can upgrade when the income level increase. Households and other potential customers demonstrate higher confidence in the SHS when they know that solar energy companies provide after-sales support and maintenances. This strategy has a positive impact on their adoption decisions and a positive effect on the profitability of the solar energy companies (Karakaya & Sriwannawit, 2015; Lo et al., 2018).

Implications for Social Change

The implications for positive social change include helping to reduce the negative impact of climate change. From the climatic standpoint, solar energy is one of the renewable energies that generate minimum emissions to the atmosphere (Seibert, 2018). When business leaders in the solar energy business craft strategies that ensure the proliferation of solar energy solutions and the adoptions by households, the temperature of the planet could reduce, and the effect on climate change is mitigated (Owusu & Asumadu-Sarkodie, 2016; Wolske et al., 2017). Solar energy business leader who ensures the adoption of solar energy solutions are

working in line with the Paris Agreement on cleaner energy for the world temperature to be below 2 degrees Celsius (Leis, 2019; Owusu & Asumadu-Sarkodie, 2016).

Using the findings from this study to improve the adoption of solar energy solutions could also lead to the profitability of the solar energy businesses. Higher profitability of the business, in turn, increases the ability of the business leaders to financially address social issues such as electrification in rural areas, electricity instability in urban areas, job creation for agents, technicians, and small businesses. This could lead to poverty reduction in the comminity (Amiraly & Sawamura, 2016; Gorevaya & Gorevoy, 2016).

The profitability of the solar energy business will lead to improved product differentiation and designs which allows the household to have more choices on the SHS to buy and that they can afford. The resultant effect of this is an environment that is green and free of poisonous gases like carbon monoxide generated from the traditional use of fossil fuels to generate energy and electricity (Gielen et al., 2019; Kesari et al., 2021; Okereke et al., 2019). When solar energy companies ensure the adoption of household solar solutions like cooking stoves for food, solar lights for lightings, and solar lanterns for reading, the health benefits on the household and the public are immense (Adenle, 2020; Hamilton, 2015; Zhang et al., 2020).

Recommendations for Action

In this qualitative multiple case study, I explored strategies that business leaders in two solar energy businesses use to maintain profitability while catering to households. The findings can benefit company leaders who wish to run a profitable solar energy business while ensuring the adoption of solar energy solutions by households. The adoption of solar energy solutions by households is critical to sales

growth and profitability of the solar energy business (Alsever, 2015; The Japan Times, 2015; Watanabe, 2014). The recommendation from this research study may aid (a) company leaders in the solar energy business who already are profitable but seeking new ideas to sustain and improve profitability, (b) company leaders in the solar energy business who struggle to run a profitable business, (c) students and researchers who desire to study strategies that solar energy business can use to run a profitable business.

Five recommended steps for action include the following: (a) identify new ways to create awareness of the solar energy solutions to households, (b) establish a variety of financing options and incentives for different customer categories, (c) develop strategies targeting the households in the rural areas, (d) identify and partner with distributors and agents having sizeable network, and (e) establish functioning after sales and maintenance support. Business leaders would benefit from these recommendations by starting with small, realistic goals with timelines to achieve each. Regular review, monitoring, assessment, and making necessary adjustments where required in their business operations and strategies will help them achieve the desired results.

The first recommendation is for solar energy business leaders to identify new ways to create awareness of solar energy solutions to households. Leaders could begin by reviewing their current offerings to see if as many people as possible are aware of the company and the solutions they offer and brainstorm to see what other measures they can take to create awareness. Example ranges from paid advertisements and campaigns on social media that pop up when people are reading emails, periodic radio and TV programs and adverts at different hours targeted for different audiences,

roadshows, market storms asides using all social media platforms to create awareness for their different solutions.

The second recommendation is to establish a variety of financing options and incentives for different customer categories. Solar energy business leaders should design more than one financing options to cater to the needs of the households. There should be different options for low, medium, and high-income households which will help them to make adoption decisions quickly. The pay-as-you-go financing option is excellent as the customer does not need to make any initial payment aside from registration or sign-on fee. The lease to own and instalments payment are other good financing options that could be established. Repayment for these financing options should be made as easy as possible such that customers can make payment online or through their phone or can be debited directly using a direct debit arrangement with a bank. Business leaders who want to maintain and improve profitability should seriously consider the installations of mini grids in strategic locations in rural and urban areas such that constant and affordable electricity could be made available to households in these communities. This will cause many households who are interested in stable electricity to migrate to this provision by the solar energy company.

The third recommendation is for business leaders to develop strategies targeting the households in the rural areas. Business leaders can start by producing little home solutions like solar lights, bulbs, lanterns, stoves, fans, and TVs that can meet the immediate needs of the households in rural areas. The next stage is to embark on rural electrification by providing mini and off-grid electricity for rural households at affordable tariffs.

The fourth recommendation is to identify and partner with distributors and agents having sizeable networks in the state or country. Business leaders can invite agents and would-be installers for free training at the company complex. These agents will go back to their various locations and become ambassadors of the company. Business leaders should identify major distributors in their locality and work with them to ensure that the solutions are available in all the corners of the community so that potential customers would not become discouraged for continuous lack of access to buy.

The fifth recommendation is to establish functioning after-sales and maintenance support. Leaders should make this fact known to the potential customers that after-sales support exists and provide a clear explanation of the way it works. Business leaders should ensure that replacement parts are well stocked in the store and have a working procedure for restock so that customers would not be disappointed when such products are required. Business leaders in the solar energy business also need to invest in online monitoring tools that will help them to manage appliances and solutions remotely especially those still under warranty such that faults can be detected and fixed proactively. A monitoring solution can be developed or purchased for use at the call center such that the relationship officers can be prompted from time to time to call subscribers at different anniversaries to find out if the customers are satisfied with the performance of the appliances.

Participants in this study will be provided with a one- or two-page summary of the study's findings via e-mail if they are interested. Plans also include publishing this study in the ProQuest Dissertations and Theses Database. Also, I will identify

opportunities to present the research findings in business meetings and other relevant forums.

Recommendations for Further Study

I conducted multiple case qualitative studies to explore what strategies solar energy business leaders use to maintain the profitability of the business. To further increase the understanding of the profitability strategies of the solar energy business, I recommend future research to address the key limitation of this study: geographic location and sample size. The participants I interviewed worked at solar energy companies headquartered in Lagos, Nigeria. Future researchers could extend the geographical location to other states in Nigeria as business leaders operating in other regions may have different strategies for profitability worth exploring. Also, the results of this study may not apply to other solar energy companies, populations, and industries. Future researchers could also use a larger sample size which may give the opportunity of capturing more insights than may have been done in this study.

I recommend that future researchers adhere strictly to the delimitations of the study. For example, they could continue to explore the profitability strategies of the solar energy business as there are still opportunities to gain more insights as technology advances, regulation changes, and the operating environment improves. Researchers could also employ purposeful sampling to identify solar energy business leaders who can effectively address the topic. However, future researchers might consider using mixed methods or a quantitative approach to incorporate empirical data on the research topic. They could also gather data from the solar energy business employees using focus groups or surveys to identify their viewpoints on strategies

their leaders use for the profitability of the business. Collecting data from company employees can help validate or counteract perspectives from the business leaders.

Reflections

When I commenced this journey, I was enthusiastic about expanding my knowledge of doctoral-level research. I avidly studied topics such as research methodologies, research designs, data collection techniques, and qualitative validity and reliability strategies. Although the preparation was purely academic, this cannot be compared to undergoing the whole process and experiencing at each stage of the journey, the challenges, frustrations, disappointments, setbacks, and the eventual successes of the program. Surmounting hurdles such as identifying a research topic, developing a problem statement, and crafting the research question and interview questions, identifying two case study organizations, securing participants, collecting data, studying, understanding the data analysis software, and analysing the data required thorough planning and determination. Looking back on the journey, I deeply respect and appreciate the strategic thinking and level of details required to plan, conduct, and present credible research.

All researchers have personal biases, preconceived ideas, and standards that could impact their data collection and analysis. I did my best to eliminate my own biases and researched without using environments where I work, have relatives and friends. Furthermore, all my interviews were conducted virtually. In addition, I used an interview protocol (see Appendix A) to ensure consistency of interview questions during my conversation with study participants. I also conducted member-checking via emails with participants to corroborate my interpretations of the data I collected.

The interview process was particularly fulfilling for me, as leaders seemed privileged to be part of the study. They were also excited to discuss their strategies for profitability and solar solutions adoption by households. I was equally astonished to realize the strategies the solar business leaders have put in place to ensure the profitability of their business. The strategies I garnered are worth sharing with the business that may want to implement in their own companies.

Summary and Study Conclusions

Ensuring the adoption of solar energy solutions is vital to sales growth and profitability of the solar energy business and helps to reduce the negative impact of climate change (Alsever, 2015; The Japan Times, 2015). However, some solar energy business leaders still lack strategies to maintain a profitable business (Fernando & Yahya, 2015; World Economic Forum, 2019). The purpose of this qualitative multiple case study was to answer the research question: What strategies do business leaders of solar energy companies that cater to households use to maintain the profitability of their business in Lagos, Nigeria? Six business leaders in two solar energy companies in Lagos, Nigeria, participated in semistructured virtual interviews to address this question. I complimented the interviews by reviewing company documents, including websites, documents shared by participants, and social media data.

Four themes emerged following data collection and analysis: (a) create awareness for solar using personal selling, social media, and online/digital channels; (b) offer attractive financing options; (c) participate in rural electrification projects targeted at low-income household and with product variations; (d) partner with distributors and agents and provide after-sales support. The findings indicated that

business leaders who leverage these strategies can increase the rate of adoption of solar energy solutions in the community and maintain the profitability of the business.

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Appendix A: Semistructured Interview Protocol and Interview Questions

<table>
<tr><th colspan="2">Interview Protocol</th></tr>
<tr><td>What the researcher will do</td><td>What the researcher will say (script)</td></tr>
<tr><td>Warm-up questions</td><td>The following warm-up questions will be asked:
- What were your reasons for establishing a solar energy business in Nigeria?
- What are the goals and objectives of your business?
- Based upon your experience, what are the key risks of establishing this type of business in Nigeria?
- What business model have you implemented to ensure the profitability of your solar energy solution business?</td></tr>
<tr><td>Introduce the interview and set the stage—often over a meal or coffee or at a private location.</td><td>Good morning or afternoon!
I want to first thank you for taking the time to participate in this research study. The purpose of this qualitative study is to understand the strategies that business leaders of solar energy companies that cater to households use to maintain profitability. The outcome may produce an understanding of what strategies other business leaders in the solar energy business can adopt to become profitable when they are having challenges to break even and become profitable. As the researcher, I wanted to assure you that the information provided will be kept confidential as indicated in your signed consent form.
The qualitative research data are collected using interviews to understand the experiences and processes from the perception of the participant. These questions are presented in an open manner to encourage you to answer as openly as possible.
The interview will last approximately 30 to 60 minutes with an additional 20 minutes at an established date to review the synthesized data captured during the initial interview.
Before we proceed are there any questions concerning the intent of this study or anything that I have stated?</td></tr>
<tr><td rowspan="7">• Watch for non-verbal queues.
• Paraphrase as needed.
• Ask follow-up probing questions to get more in-depth</td><td>1. What strategies have you used to achieve and maintain profitability using your chosen business model</td></tr>
<tr><td>2. What strategies did you use to communicate the need for, and benefits of, solar energy to potential customers?</td></tr>
<tr><td>3. How did you assess the effectiveness of your strategies for achieving and maintaining profitability?</td></tr>
<tr><td>4. What were the key obstacles to implementing your organization’s strategies in maintaining profitability using your chosen business model?</td></tr>
<tr><td>5. How did your organization address the key obstacles to implementing its strategies?

6. What strategies did you use to identify factors that influence how quickly residents are adopting solar energy?</td></tr>
<tr><td>7. What other insights would you like to add regarding your organization’s strategies for achieving and maintaining profitability from serving its household customers?</td></tr>
<tr><td></td></tr>
<tr><td>Wrap up interview thanking participant</td><td>This concludes the interview and I want to thank you again for your participation.</td></tr>
<tr><td>Schedule follow-up member checking interview</td><td>The follow-up meeting to discuss the synthesis of the information interpreted from each question should last approximately 20 to 30 minutes.</td></tr>
</table>

	What date and time frame would you like to be scheduled?
Follow–up Member Checking Interview Member checking involves the process of checking with research participants whether the identified concepts and codes fit one's personal experience (Carson, 2010).	
Introduce follow-up interview and set the stage	Thank you for this follow-up member checking meeting to review for validity that the synthesized data represent the correct answers. If I missed anything or you like to add anything, please feel free to add that information as we review.
Share a copy of the succinct synthesis for each question Bring in probing questions related to other information that you may have found—note the information must be related so that you are probing and adhering to the IRB approval. Walk through each question, read the interpretation, and ask: Did I miss anything? Or, is there anything you would like to add?	Question and succinct synthesis of the interpretation
	1. Question and succinct synthesis of the interpretation—perhaps one paragraph or as needed
	2 Question and succinct synthesis of the interpretation—perhaps one paragraph or as needed
	3 Question and succinct synthesis of the interpretation—perhaps one paragraph or as needed
	If there is no additional information that you would like to add, this concludes the follow-up meeting. Thank you for your contribution of time and knowledge to this study.