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Factors Influencing Managers-Owners of Micro, Small, and Medium Enterprises (MSMEs) Willingness to Adopt Solar Technology in Anambra State Nigeria

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Abstract

Micro, small, and medium enterprises (MSMEs) are the engines that drive economic growth in Nigeria, but it has been hampered by harsh macro-environments such as lack of access to finance and inadequate power supply. This study investigates the factors that influence the solar technology adoption intention of managers-owners of MSMEs in Anambra State, Nigeria. A survey questionnaire was administered to 450 respondents who are managers-owners of MSMEs in the state. AMOS-23 was used to analyse the data. The findings showed that managers'-owners' attitude towards behaviour and their perceived potential benefits of solar technology were positive and statistically significant factors influencing solar technology adoption intention. However, managers'-owners' disruptive innovation activities (DIA) and perceived cost were not statistically significant in predicting adoption intention. Additionally, social trust was found to influence attitude but not necessarily influence a manager's-owner's intention to adopt solar technology. The findings suggested a need for cooperation among relevant stakeholders and a strong political will from the government to understand and promote solar technology in Nigeria to remedy the power shortages caused by a huge gap between power demand and supply.

Keywords: adoption intention, attitude, disruptive innovation activities, perceived benefits-cost, solar technology, social trust
JEL Classifications: D04, D91, E71, H25, K32, Q01, Q42

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1. Introduction

A steady and uninterrupted power supply plays a vital role in the modern-day economy as it supports the economic growth, sustainable development, and poverty eradication (Oyedepo, 2012). The availability, accessibility, and affordability of a steady power supply are crucial for any nation's long-term economic growth (Schumpeter, 2017). The importance of an uninterrupted power supply is becoming more evident due to rapid population growth, urbanization, and industrialization; and a stable energy supply is critical for business activities that fuel productivity, in particular, the micro, small, and medium enterprise (MSMEs) such as manufacturing businesses, agriculture, industry, commerce, and mining that are fast-growing in Nigeria, as well as for households' basic needs. According to Nnaji (2010), when there is a lack of access to a stable power supply for business activities, it limits economic activities, leading to economic decline, low productivity, and poverty. Furthermore, for sustainable development, access to clean and affordable energy for all is pivotal in poverty reduction, socio-economic development, and increase in a nation's productivity, which leads to income growth, education, and health are all interwoven, posited Nnaji (2010). This paper argues that aside from the perceived benefit in terms of cost-benefit analysis, the government incentives as benefits through policy support are vital factors that will motivate solar technology adoption intention. There is a huge gap between power demand and supply in Nigeria presently, which hinders the productivity of businesses and economic growth. The share of solar technology in the current energy mix remains insignificant compared to other sources. (See Table 1 below), which warrants investigating the factors that might shift the energy mix policy in Nigeria. The problem of power supply in Nigeria and the prospect of solar technology as a viable alternative to provide stable access to power, the literature review on solar technology adoption intentions, the findings of the study, and recommendations for relevant stakeholders were discussed in detail in the subsequent parts of this research.

Table 1: Current and Future Electricity Mix in Nigeria

Technology Type	**Capacity (MW) 2003**	**Additional capacity (MW) 2010**	**Additional capacity (MW) 2020**	**Additional capacity (MW) 2030**
Hydro	1920		4740	5748
Biomass	-	-	5	5
Wind	-	-	20	20
Solar PV	-	-	75	425
Solar Thermal	-	-	1	20
Total Addition		7289	8280	12,858
Cumulative Total	6472	13,761	20,276	29,394

Source: Adapted from Aliyu, Dada, and Adam (2015)

1.1 Problem Statement

According to Suanmali, Kokuenkan, Lohananthachai, Kumpong, and Suwatanapornchai (2018), a stable power supply is a necessity for business activities and everyday life in the twenty-first century. The authors argued that power generation supplied to the national grid, which is mostly non-renewable energy source, is insufficient to meet the demands of the increasing urban population for both business activities and

household usage. This insufficient power supply will eventually lead to a search for an alternative source of energy (Damasen I Paul & Uhomoibhi, 2012; Damasen Ikwaba Paul & Uhomoibhi, 2014). The argument here is that, among the alternative sources of energy, solar technology is a viable alternative that is renewable and efficient if it is available, accessible, and affordable when compared to the current stand-alone generators being used by MSMEs in Nigeria. To elaborate, the magnitudes of MSMEs managers'-owners' intention to adopt solar technology in Nigeria from this research perspective are three-fold: economic, social impact, and sustainable development impacts. Notwithstanding the importance of a steady power supply for economic and sustainable development, Nigeria is the largest economy in Africa but still struggling to supply the power needed for businesses to thrive, according to Abdullahi, Renukappa, Suresh, and Oloke (2021). The government's inability to generate and supply steady electricity in the country has impacted the gross domestic product and lower productivity. Although this study focused on Anambra State as a case study, it is important to note that the problem in the energy sector is rather a general problem in Nigeria regardless of the region, as the energy policy resides in the federal government of Nigeria and not the state government. According to Ozoegwu, Mgbemene, and Ozor (2017), around 40% of Nigeria's population is not connected to the national grid, and some areas that are connected are plagued by recurrent power outages. Additionally, Ohunakin, Adaramola, Oyewola, and Fagbenle (2014) noted that only a few urban cities in Nigeria are connected to the national grid with limited electricity access for MSMEs' business activities, industrial power demand as well as households energy usage. Moreover, Mohammed, Mustafa, Bashir, and Ibrahem (2017) estimated the power supply and demand gap in Nigeria to be roughly 76% as of the year 2016. To that effect, Ezennaya, Isaac, Okolie, and Ezeanyim (2014) predicted that Nigeria needs to generate around 20,000 megawatts to meet the demand for electricity in the country. However, the country produces only about 4,000 megawatts of electricity presently, which results in a power shortage and makes it difficult and practically impossible for small businesses to perform efficiently.

1.2 The Local Energy Realities-News on Power Status in Nigeria

The figures (1, 2, and 3) below, represent a glimpse of the instances of the power status in Nigeria and the example of the current situation of lack of solar energy use and dependence on the stand-alone generator. The Nigerian power calamity is detrimental to the MSMEs, as reported by both local and international news outlets. The cost of running stand-alone generators is skyrocketing, making the economic environment difficult and challenging for MSMEs to run their businesses.

Figure 1: News on Power Problem-1[1]

[1] https://gazettengr.com/abuja-business-owners-to-pay-tax-for-using-generators/ (Accessed on 25 October 2021)

Figure 2: News on Power Problem-2[2]

Figure 3: News on Power Problem-3[3]

On the topic of power problems killing the MSMEs and industries in Nigeria, Akinwunmi Adesina, the President of the African Development Bank Group (ADB) while addressing the Manufacturers Association of Nigeria (MAN) lamented that: *"paucity of energy was negatively affecting the growth of Nigerian industries."* According to him, *"Today, no business can survive in Nigeria without generators." Adesina said, "Consequently, the abnormal has become normal". "Unless Nigeria decisively tackles its energy deficiency and reliability, its industries will always remain uncompetitive."*[4] The energy problem has been acknowledged by many researchers as depicted above, and the stand-alone generators are mostly used, which prompted this study to understand why MSMEs are not using solar technology instead.

Moreover, many experts believe that solar technology is one of the most promising technologies among renewable energies. Solar technology is suitable for MSMEs in Nigeria because the country is located near the equator in the Sub-Saharan African region. Nonetheless, the government has failed to take the opportunity and deploy a small fraction of its land to generate electricity from solar photovoltaic (PV)

[2]https://www.aljazeera.com/economy/2021/9/27/power-problems-could-solar-solve-nigerias-electricity-woes (Accessed on 25 October 2021)
[3]https://www.ft.com/content/13e73f98-a512-11e7-8d56-98a09be71849 (Accessed on 25 October 2021)
[4]https://www.channelstv.com/2021/10/26/lack-of-electricity-killing-nigerian-industries-adesina/ (Accessed, October 29, 2021)

(Giwa, Alabi, Yusuf, & Olukan, 2017). Figure 4 depicts the sources of energy in Nigeria, and solar technology is still very low when compared with other sources.

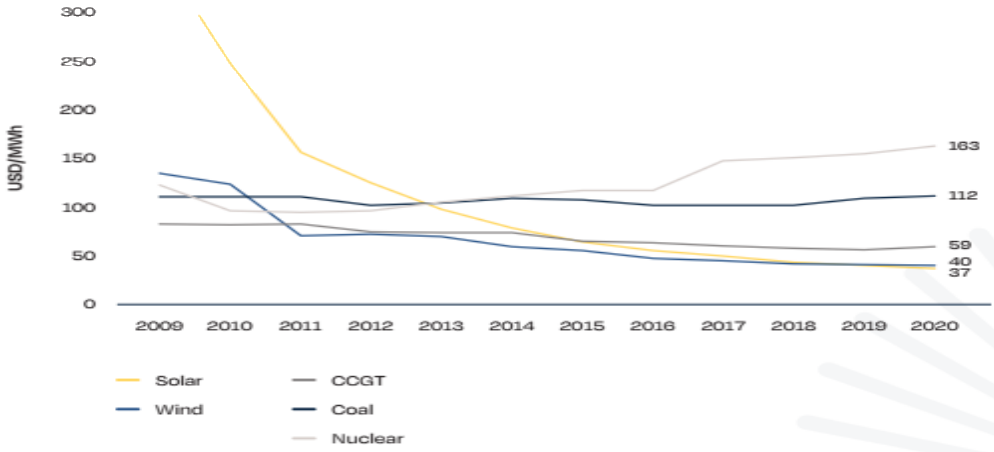
Figure 4: Sources of Electricity Generation in Nigeria[5]

Source: USaid.gov

The government agencies as stakeholders have inactively failed to harness other sources of energy, particularly solar renewable energy resources, to mitigate the imbalance of power demand and supply gap in Nigeria (Babakatcha, Yabagi, Ladan, & Oladipupo, 2020). The lack of policy support to make solar technology available, accessible, and affordable is one of the reasons for its slow adoption (Global Market Outlook: Europe, 2017). This vacuum has resulted in people sourcing for energy alternatives, which are mainly stand-alone generators in Nigeria, which are non-renewable and cost-inefficient. Loveldy, Ismail, and Jubaedah (2021) stated that solar technology has been acknowledged to be a safe, boundless, and non-polluting alternative energy source. However, despite advances in technology, in Nigeria, Micro, Small, and Medium Enterprises (MSMEs) still rely heavily on fossil fuel stand-alone generators for electricity. Although investment in solar technology is rapidly growing, the importance of the adoption intention cannot be overemphasized for all the problems identified in this study. Reliance on fossil fuel generating sets is not a sustainable source of electricity and certainly not efficient. A sustainable source of energy like solar technology provides energy that is environmentally friendly, more efficient, and economically viable as it meets the present energy needs without compromising the future needs (Stritih et al., 2015). Therefore, from these perspectives, power shortages in Nigeria are affecting business activities, so adopting solar technology as an alternative source of electricity is vital and needs to be highlighted. However, from Global Market Outlook: Europe (2017), Africa and Nigeria in particular are not embracing solar technology despite the advancement in the battery and cheaper cost. See Figure 5 for solar electricity generation costs in comparison with other power sources from 2009-2020. The figure shows the decrease in the cost of solar technology over the years, which this paper argued that could be a motivating factor for adoption intention.

[5] https://www.usaid.gov/powerafrica/nigeria (Accessed, October 29, 2021)

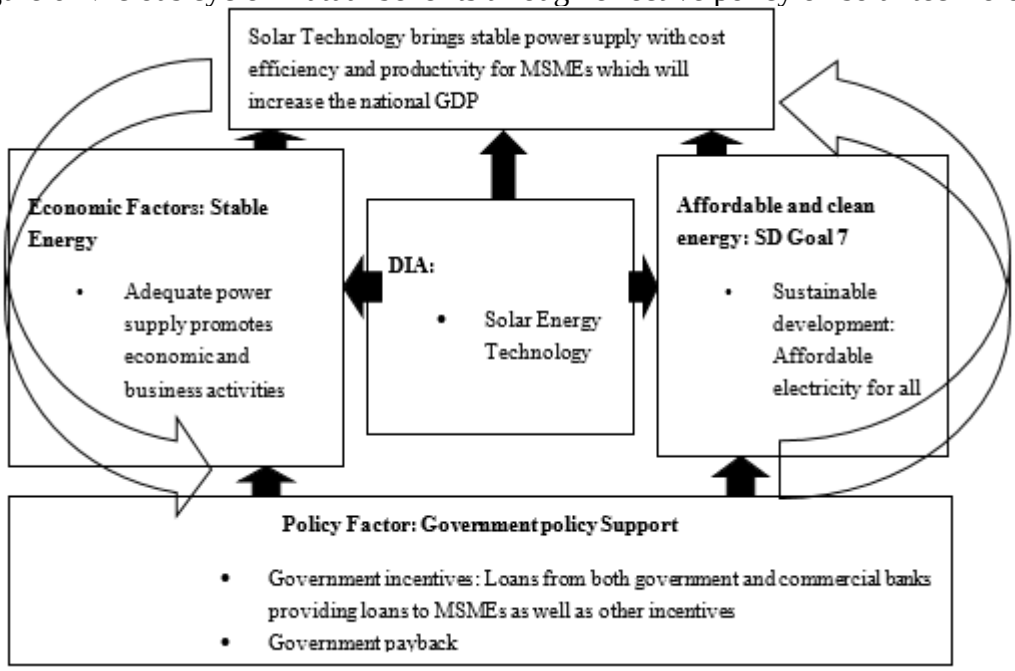
Figure 5: Decline in Solar Cost



Source: Adopted from Global Market Outlook: Europe (2017)

Hence, it is imperative to understand the attitude and perception, perceived benefits, perceived cost, perceived social trust, and disruptive innovation activities of the MSMEs managers-owners as energy consumers and provide recommendations to the stakeholders concerned, which are the government agencies responsible for power as well as the solar technology companies (suppliers and installation companies). Figure 6 below illustrates the mutual benefits that can be derived if the government formulates and implements effective policies on renewable energy in Nigeria.

Figure 6: Vicious cycle: Mutual benefits through effective policy on solar technology



Source: Adopted from Ajah and Pathranarakul (2022)

1.3 Aims and Objectives of the Study

- To investigate the relationship between attitude-behaviour towards the behaviour of managers-owners of MSMEs and their intention to adopt solar technology.

- To investigate how perceived social trust, perceived benefits, or cost separately and interactively contribute to or deters a manager's interest in adopting solar technology.
- To explore managers-owners of MSMEs' disruptive innovation activities' influence on their intention to adopt solar technology.

1.4 The Features of Micro, Small, and Medium Enterprise (MSMEs) in Anambra State, Nigeria

Anambra State has a reasonably large number of MSMEs. According to the Nigeria National Bureau of Statistics Collaborative Survey, the state is ranked 9th out of 36 states in the country with an estimated number of 1,223,395 MSMEs (SMEDAN, 2013). It is a fact globally that micro, small, and medium enterprises (MSMEs) are vital to economic growth and development (Schumpeter, 2017) and 96% of the local businesses in Nigeria are classified as SMEs according to the International Finance Corporation (IFC). Moreover, Ebitu, Glory, and Alfred (2016) postulated that MSMEs are imperative for economic development, growth, and job creation, which need robust support for sustainable development and for improving living standards and poverty alleviation. The MSMEs provide most of the employment opportunities, which is also a key indicator of the overall performance of an economy according to Udu (2015). Even though MSMEs are an important apparatus for development, economic growth, and employment creation in Nigeria, poor absorptive power infrastructure and limited funds have been identified as the pinnacle factors that have hampered the development of MSMEs (Taiwo, Ayodeji, & Yusuf, 2012).

MSMEs in Nigeria are classified as follows; first, "Micro Enterprises are those enterprises whose total assets (excluding land and buildings) are less than five million Naira with a workforce not exceeding ten employees". Secondly, "Small Enterprises are those enterprises whose total assets (excluding land and building) are above five million Naira but not exceeding fifty million Naira with a total workforce of above ten, but not exceeding forty- nine employees". Lastly, "Medium Enterprises are those enterprises with total assets (excluding land and building) are above fifty million Naira, but not exceeding five hundred million Naira with a total workforce of between 50 and 199 employees" (SMEDAN, 2013).

2. Background of the Study

2.1 The Status of Electricity/Power Problems in Nigeria

Abdullahi et al. (2021) noted that "electricity is crucial to socio-economic development, especially in Nigeria, which is one of the biggest economies and most populous nations in Africa." The Manufacturers Association of Nigeria (MAN), and the National Association of MSMEs (Small-Scale Industries) estimated that its members spend an average of around NGN 2 billion ($12 million) per week on fossil fuel to operate their stand-alone generators, as stated by Aladejare (2014). This clearly shows that the main source of power supply for MSMEs is stand-alone generators, and the overall power grid access of both MSMEs and households is 60 percent (see Figure 4). Due to currency exchange fluctuations and other economic challenges in Nigeria, 12 million dollars is approximately 5 billion NGN at the time of this study (US dollar equivalent as of March 30, 2022: USD 1= NGN 415). On average, spending on fuel is approximately 4 thousand NGN, which is expensive for MSMEs, particularly the micro and small businesses in Nigeria. To this end, a steady and uninterrupted power supply that is available, accessible, and affordable propels a nation towards sustainable development.

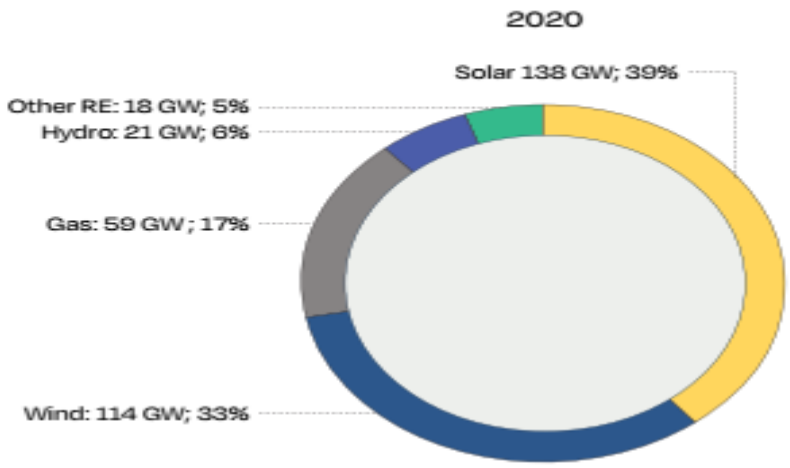
2.2 An Overview of Solar Technology in Nigeria

This study focused on "Photovoltaic systems" (PV) that convert sunlight to electricity. This is a kind of solar energy technology installed on top of the building's roof to generally generate power for businesses and households. The benefits of solar technology are numerous. For instance, it provides a proven source of electricity using technology that has no emissions in operation, and it is readily used in urban environments without requiring additional land use, which is good for MSMEs that mostly use rented spaces (Faiers, 2009). Solar technology in Nigeria is gaining market momentum. Although it is relatively new, only a fraction of businesses has been able to identify and capture the opportunity for their business. Solar technology can be a singular solution to the world's energy needs and the trend of installation is increasing elsewhere, apart from Africa (Global Market Outlook: Europe, 2017).

2.3 Solar Technology Prospects

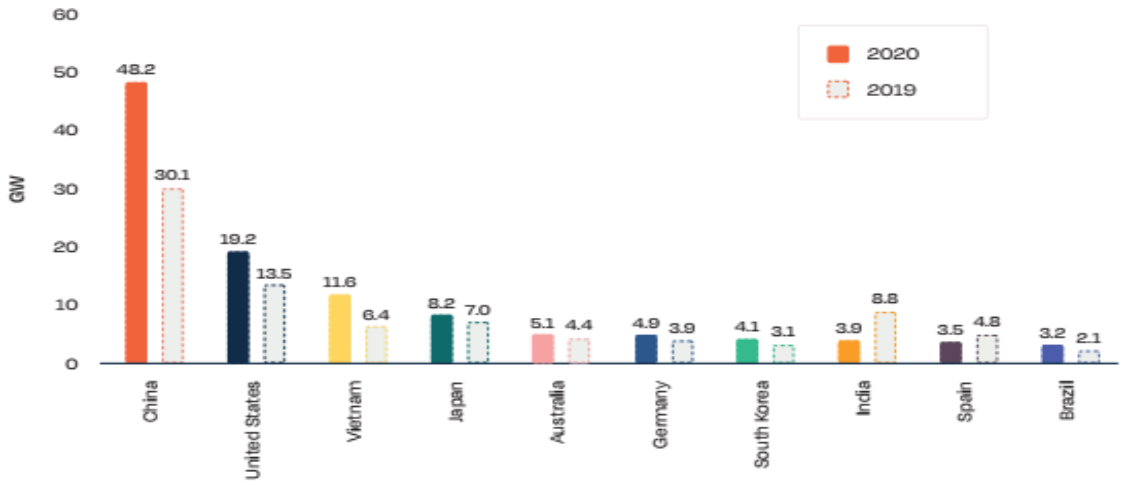
Solar technology has led in annual global installations for the past few years, which is indeed a very positive development. The good news when talking about the long-term perspective is that solar technology continues to take the market share of the energy sector globally, and it is continuously increasing. There is no end in sight as it strives for more improvements in cost competitiveness. Therefore, the potential for solar power will continue to only grow (Global Market Outlook: Europe, 2017). See figure 7 for the net power generating capacity added in 2020 by main technologies.

Figure 7: Solar technology Leads to Annual Global Power Installations in 2020



Source: Global Market Outlook: Europe (2017)

Figure 8: Solar PV Markets, 2019-2020



Source: Global Market Outlook: Europe (2017)

According to the "Global Market Outlook for Solar Power 2021-2025" (Europe, 2017), the installations of solar technology as depicted in Figure 8 were mainly in the west and some other countries. "The African Continent was dominated by South Africa, which exceeded the GW-level deployment for the first time by installing 1.3 GW in the utility and distributed segments, a 154% improvement over the previous year. South Africa has seen the start of a solar renaissance under its current president" (Europe, 2017). However, the adoption of solar technology is still limited in Africa. So, the perception of solar technology is still blurred in African countries. Therefore, to understand what motivates or changes the attitude and perception toward the adoption of solar technology is imperative to explore Africa and Nigeria precisely. It is important to understand why the slow adoption of solar technology even against all the odds faced each day due to power shortages in Nigeria, as indicated earlier. Hence, this research will fill this gap by exploring the attitude and perception, perceived benefits, perceived cost, social trust, and DIA influence on managers-owners of MSMEs' solar technology adoption intentions.

3. Literature Review, Theoretical background, and Hypotheses Development

Different theories such as the theory of planned behaviour (TPB), innovation diffusion theory (IDT), theory of rational action (TRA), etc. have been adopted by different scholars to examine the behavioural and psychological factors influencing an individual's solar technology adoption intention. The Theory of Planned Behaviour (TPB) and Disruptive Innovation Theory (DIT) and other variables derived from the literature were adopted and integrated to examine MSMEs' managers-owners intention to adopt solar technology for business purposes in Anambra State, Nigeria. This section explored all the variables adopted in this study.

Solar Technology Adoption Intention

According to Hai (2021), intention refers to "a course of action or plan that an actor considers necessary and thus intends to undertake to accomplish a certain behaviour." Additionally, Faiers (2009) stated that "the adoption of innovations is a point in time when the adopter of an innovation decides to use the innovation in question." The intention is defined as a motivational factor and willingness of a person to engage in

certain behaviours (Ajzen & Fishbein, 2005). Hence, managers-owners of MSMEs' intention in this study means the intended decision to act/adopt solar technology or not to adopt it for business activities and purposes.

Attitude Towards Behaviour

From the Theory of Planned Behaviour (TPB), attitude is defined as "the perceived level of positive and negative impressions toward acting on the particular behaviour" according to Ajzen and Fishbein (2005). The authors stated that an attitude is a predisposition learned to respond in a certain way, either as favourable or unfavourable to a given object. Attitude towards behaviour in this present study means the managers-owners of MSMEs' attitudes towards solar technology as favourable or unfavourable, which motivates their intention to adopt or not to adopt solar technology for their business purposes. On that note, businesses and policy decision-makers' understanding of the psychological processes of attitude toward solar renewable energy technology adoption is vital (Claudy, Peterson, & O'driscoll, 2013). Previous studies have found relationships between the variables. For instance, Jorns (2020) and H. Kim, Park, Kwon, Ohm, and Chang (2014) found that attitude towards behaviour has a positive relationship with adoption intention. Thus, the first hypothesis was formulated as follows:

H1. *There is a positive relationship between attitude towards behaviour and solar technology adoption intention.*

Perceived Benefits

Scholars have identified perceived benefits and incentives from the government as a key factor that influences solar technology adoption intentions. Additionally, government incentives can be perceived as an opportunity or barrier to solar technology adoption intention. Global Market Outlook: Europe (2017) report noted that it is no surprise that countries blessed with high solar irradiance and supported by a stable policy framework can achieve very competitive prices, which can influence the decision to adopt or not to adopt solar technology. Moreover, Caird, Roy, and Herring (2008) stated that "the adopters of energy efficiency measures do so for many reasons; from their research, the main drivers were saving energy, reducing fossil fuel cost, and concern for the environment". Furthermore, Chen, Lin, and Cheng (2013) and Kim, Park, and Ohm (2014) posited that an individual's perceived benefit is pointedly linked with the individual's attitude towards new technology. Consumers' perceived potential technology benefits directly or indirectly influenced their behaviour and attitude towards adoption intention of the new technology (Mathieson, 1991). According to Claudy et al. (2013), economic, environmental, and independent benefits are factors that influenced the reason for adoption, which was also echoed by other proponents like Loveldy et al. (2021). In addition, (Garcia, Bardhi, & Friedrich, 2007; Kleijnen, Lee, & Wetzels, 2009) stated that, when consumers see solar technology products as having potential benefits aligned to their beliefs and values, they will embrace and adopt the technology. Therefore, the working definition of perceived benefits for this present study is the potential cost savings of buying fossil fuels to power stand-alone generators; reliable power supply free of the unreliable national power grid; and potential incentives from the government. Hence, the variable was hypothesized as follows:

H2. *There is a positive relationship between the perceived benefits of solar technology and attitudes towards behaviour.*

H3. *There is a positive relationship between the perceived benefits of solar technology and solar technology adoption intention.*

Perceived Costs

The perceived cost has been one of the major elements in solar adoption intention. Notwithstanding the significant advancement in solar technology that reduces the overall cost, the up-front or initial and maintenance cost is still considered to be a barrier according to Board (2020), especially to micro and small businesses. Alam et al. (2014) defined cost as "the cost of the initial investment to install and set up the solar technology system as well as the maintenance costs over time". Furthermore, Museli and Navimipour (2018) stated that potential adopters are concerned about the cost associated with new technology. When estimating adoption intention, potential adopters usually compare the perceived benefits against the perceived cost of the technology, stated Park and Ohm (2014), and this cost issue is also applicable to solar renewable energy technology (H. Kim et al., 2014). In this study, perceived cost means the installation and maintenance cost of solar technology for MSMEs businesses. This paper argued that perceived cost might relate or differ in terms of managers-owners of MSMEs' perception of cost and households' usage. Most of the literature on solar technology adoption intention was conducted on a household, whereas this study is based on MSMEs, which consider the cost as part of the operational cost for running their businesses, and thus perceive the installation and maintenance cost differently than the household usage. Recent research has found a relationship between cost and intention. For example, Alam et al. (2014) indicated that perceived cost has a moderate effect on small-scale businesses and households' renewable energy adoption intentions. Additionally, Park and Ohm (2014) posited that perceived cost is one of the primary elements influencing solar technology adoption intentions before the Fukushima nuclear accident. Consequently, hypotheses 4 and 5 were developed as follows:

H4. *There is a negative relationship between perceived costs and attitudes towards behaviour.*

H5. *There is a negative relationship between perceived costs and solar technology adoption intention.*

Perceived Social Trust

Social trust is a perceived social pressure on an individual to act on a specific behaviour. People are usually influenced to act on the perceptions of others. A manager-owner of a small business may imitate someone (peers or neighbours) perceived as guidance or for reducing the risk associated with new technology (Ajzen, 2002). Perceived social trust is defined in this study as the managers-owners of MSMEs' intention to act on adopting solar technology or not, which is potentially influenced by other people with whom they have a close relationship or their business neighbours. Moreover, Fischer and Sauter (2004) noted that social reference influenced both acceptance and resistance towards solar technology adoption, as friends and neighbours are important references to understand the solar system cost and durability before investing. Besides, Westaby (2005) contends that behavioural theory promotes social influences and trust, which factor as a comprehensive motive along with attitude towards behaviour as the primary antecedents for solar technology adoption intention. Several studies have found that perceived social trust is generated by the social atmosphere of a society or is mainly associated with other users in that society. This social trust significantly influences the managers-owners of MSMEs' attitudes toward the technology (H. Kim et al., 2014). Although authors have used this variable (perceived social trust as used in this study) with various names like the subjective norm in TPB & TRA; image in IDT, and social factors in MPCU, respectively, the meaning of the construct encompasses the idea that the behaviour of someone seen as an important

person has influenced another person's perception to perform a certain behaviour, which is to adopt solar technology in this context (Venkatesh, Thong, & Xu, 2012). In terms of the empirical relationship between the variables, Feng (2012) found that social trust has a significant influence on the solar technology adoption intention. Accordingly, hypotheses 6 and 7 were developed as follows:

H6. *There is a positive relationship between social trust and attitudes towards behaviour.*
H7. *There is a positive relationship between social trust and solar technology adoption intention.*

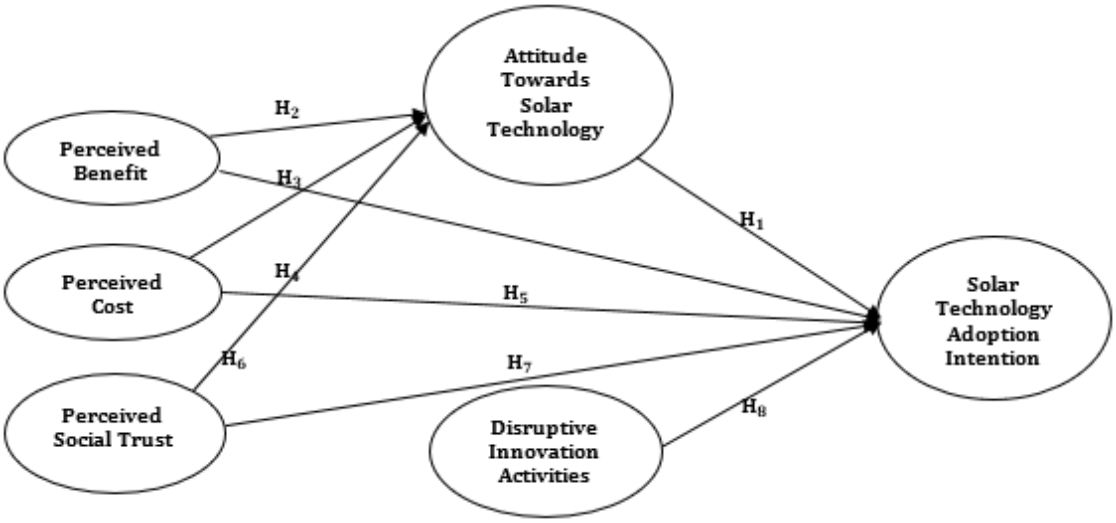
Disruptive Innovation Activities (DIA)

Disruptive innovation (DI) is defined by Christensen and Bower (1996) as "a technology, product, or process that creeps up from below an existing business and threatens to displace it". Thomond, Herzberg, and Lettice (2003) stated that "disruptive innovation, disruptive technologies, and disruptive business strategies are emerging and increasingly becoming a prominent business terms that are used to describe a form of revolutionary change". Furthermore, Sadiq, Hussain, and Naseem (2020) indicated that DI can change the market status quo dramatically and overturn the incumbents by creating new market dynamics. This paper defined disruptive innovation activities (DIA) as the managers-owners of MSMEs' inclination and personality regarding technology. Their perception of the potential benefits of solar technology might influence their decision to adopt or not to adopt solar technology for their small business activities. According to Siegel (2003), DI technology influences managers-owners of MSMEs' perception to adopt solar technology because of the perceived intrinsic value for operational efficiency and effectiveness rather than the bubble. DI technology can either be perceived as an opportunity or a threat to MSMEs depending on the disruptive innovation activities of the business manager-owner. To this effect, if managers-owners recognized DI as an opportunity with potential benefits to their business, it would motivate their intention to adopt solar technology and vice versa. Sadiq et al. (2020) defined disruptive innovation activities (DIA) as synchronized and focused efforts that strain to exploit or at least initiate the DI process. DIA internal factors have influenced managers-owners of MSMEs' solar technology adoption intentions. The internal factor is the personality attributes, technological inclination, and the willingness of managers-owners of MSMEs to adopt innovative products as pustulated by Chen, Zhu, and Zhang (2017). Moreover, Sadiq and Hussain (2018) emphasized that managers-owners of MSMEs DIA are anticipated to nurture and generate DI. Hence, hypothesis 8 was developed as follows:

H8. *There is a positive relationship between DIA and solar technology adoption intention.*

The research framework of the study is depicted in Figure 9 which illustrates the relationships between the independent, mediating, and dependent variables of the study.

Figure 9: A research framework



Source: Author's contribution

4. Materials and Methods

4.1 Research Design, Target Population, and Pilot Testing

According to Bell, Bryman, and Harley (2018), a research strategy is the overall coordination of how the research is conducted, either as a quantitative or qualitative strategy. This research used the quantitative method of a cross-sectional survey where data was collected at one point in time. The target population consisted of 1,441,047 managers-owners of MSMEs in Anambra State, Nigeria (SMEDAN, 2013). Babbie (2013) recommended a minimum of thirty respondents for pilot testing, therefore, 50 respondents' samples were used for a pilot test about the timing and how difficult it was to understand the questions, and adjustments were made from their feedback before the research instruments were finalized. A total of 450 questionnaires were collected through an online survey. However, after removing the outliers using Mahalanobis distance (Mahalanobis, 1936), 400 survey responses were used for the data analysis after the data cleaning process. The datasets contained no missing data as respondents could not submit the survey unless they had filled in all the questions in the questionnaire. Data collected includes six parts relating to intention, attitude, perceived benefits, perceived costs, perceived social trust, and DIA measurements. The questionnaire consists of 25 items that seek to measure the constructs, and all the items were adopted from previous studies. Managers-owners were asked to identify their opinion on each item on a 5-point Likert scale ranging from 1= strongly disagree to 5= strongly agree.

Table 2: The Number of Indicators and Sources of the Instruments Used in this Study

Factors	**Indicators**	**Sources**
Intention	STA1, STA2, STA3, STA4, STA5	(H. Kim et al., 2014; Loveldy et al., 2021), (K. K. Chen, 2014)
Attitude	ATT1, ATT2, ATT3, ATT4, ATT5	(H. Kim et al., 2014; Loveldy et al., 2021)
Perceived Cost	PC1, PC2, PC3	(Jorns, 2020; H. Kim et al., 2014; Loveldy et al., 2021)
Perceived Benefits	PB1, PB2, PB3	(Jorns, 2020; H. Kim et al., 2014; Loveldy et al., 2021)

Factors	Indicators	Sources
Perceived Social Trust	PST1, PST2, PST3	(H. Kim et al., 2014)
Disruptive Innovation Activities	DIA1, DIA2, DIA3, DIA4, DIA5	(Sadiq et al., 2020)

Source: Author cited from previous studies

4.2 Sampling Procedures and Sample Size

According to McDonald, Gan, Fraser, Oke, and Anderson (2015), a sampling procedure is the process of selecting a set of individuals able to represent the whole population from the targeted population that the proponent wishes to study. The sampling techniques are classified as probability or non-probability (Saunders, Lewis, & Thornhill, 2016). A sample size of 400 MSMEs managers-owners was collected using convenience sampling from a non-probability technique because random sampling was not feasible for the scope, which makes other research methods impractical (Creswell & Creswell, 2017). Yamane *(*1967*)* formula was used to calculate the sample size because the population is finite and known. The estimated number of registered MSMEs in Anambra State is 1,223,395, which employs around 1,441,047 people in the MSMEs sector in Anambra State according to SMEDAN (2013).

4.3 Measurement of Validity and Reliability

The construct validity, which includes discriminant validity and convergent validity, was examined to confirm the research measurements. The construct validity and the convergent validity were confirmed through confirmatory factor loadings *(*CFA*)* greater than 0.5, the average variance extracted *(*AVE*)* higher than 0.5, and composite reliability *(*CR*)* above 0.7 as recommended by Hair Jr, Hult, Ringle, and Sarstedt (2021). In addition, the discriminant validity was scrutinized by comparing "the square root of average variance extracted (AVE) with the correlation of itself to other variables". "The square root of AVE of the construct has to be greater than any correlation that is involved" (ibid). Concerning the CR and AVE, see Figure 10; for the CFA see Figure 11. Moreover, various indices were employed to test the overall goodness of the fit model (see Table 3). The model fit criteria were adopted from Meyers, Gamst, and Guarino (2016, p. 559), and the Graphic Software of AMOS-23 was used to analyse the data. The chi-square test is sensitive to sample size. However, if the model degree of freedom, otherwise known as the relative chi-square, did not exceed 5.0, it is assumed to demonstrate a reasonable fit, as noted by Kline (2015). All the criteria were met, hence, no issue of validity and reliability in the construct.

Figure 10: Model Validity Measures

Model Validity Measures

	CR	AVE	MSV	MaxR(H)	DIA	Intent	Perceived_Cost	Perceived_Trust	Perceived_Benefit	Attitude
DIA	0.919	0.742	0.493	0.963	**0.861**					
Intent	0.870	0.630	0.258	0.904	-0.031	**0.794**				
Perceived_Cost	0.811	0.542	0.493	1.077	0.702***	-0.053	**0.736**			
Perceived_Trust	0.880	0.716	0.017	0.938	0.117†	-0.119*	0.055	**0.846**		
Perceived_Benefit	0.860	0.674	0.326	0.895	0.054	0.399***	0.016	0.024	**0.821**	
Attitude	0.844	0.644	0.326	0.850	0.018	0.508***	0.033	-0.129*	0.571***	**0.803**

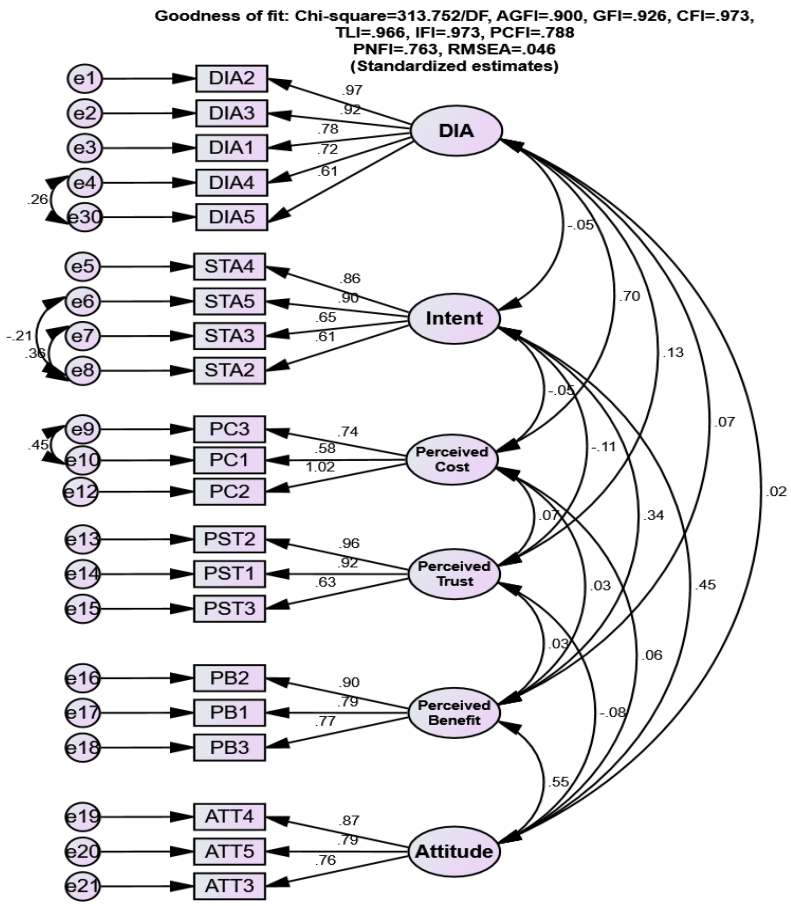
Validity Concerns

No validity concerns here.

Source: Hu and Bentler (1999): "Cutoff Criteria for Fit Indexes in Covariance Structure Analysis: Conventional Criteria Versus New Alternatives" SEM. Extracted from Gaskin and Lim (2016) "Master Validity Tool", AMOS Plugin

*Note: Significance of Correlations: † p < 0.100, * p < 0.050, ** p < 0.010, *** p < 0.001*

Figure 11: CFA



Source: Extracted from AMOS-23 Output

Table 3: Statistical Results for the Overall Goodness of Fit Model Extracted (AMOS-23)

The Overall Goodness of Fit Model Criteria and Results								
Absolute			**Relative**			**Parsimonious**		
Indices	**Criteria Value**	**Results**	**Indices**	**Criteria Value**	**Results**	**Indices**	**Criteria Value**	**Results**
Chi-square	p >0.05	**0.000**	CFI	>0.90	**0.934**	PCFI	>0.50	**0.756**
CMIN/DF	< 5.0	**1.361**	TLI	>0.90	**0.919**	PNFI	>0.50	**0.645**
GFI	>0.90	**0.945**	IFI	>0.90	**0.937**			
AGFI	>0.80	**0.925**						
RMSEA	<0.10	**0.030**						

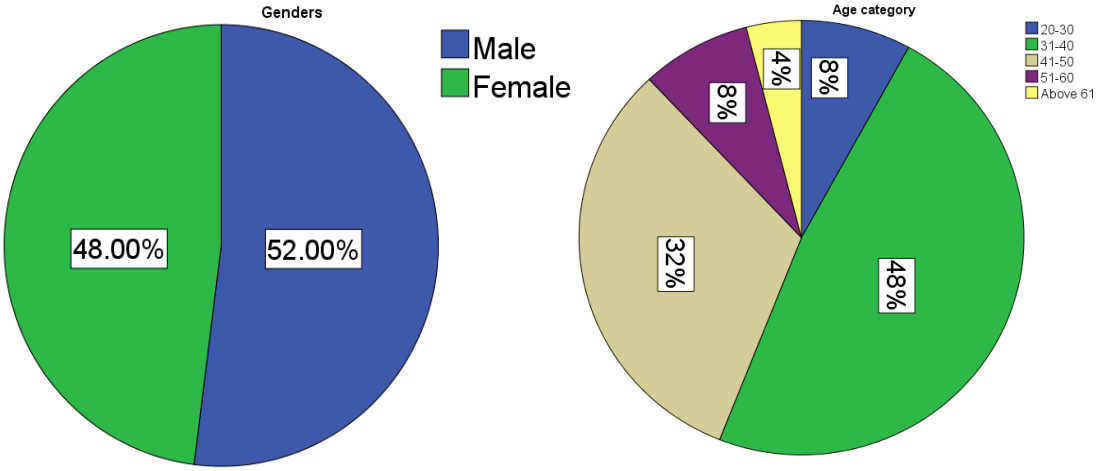
Source: Goodness of Fit Criteria Adapted from Meyers et al. (2016, p. 559): Applied Multivariate Research: Design and Interpretation

5. Results

5.1 Descriptive Results: Demographic Profile of the Respondents

From the 400 samples collected and analyzed, most of the respondents were male. However, there is not much gender difference, which is 52% male and 48% female, respectively. Furthermore, most of the managers-owners of MSMEs respondents were within the age range of 31-40 (48%), followed by 41-50 (32%), and the rest are 8% & 4%, respectively (see Figure 12).

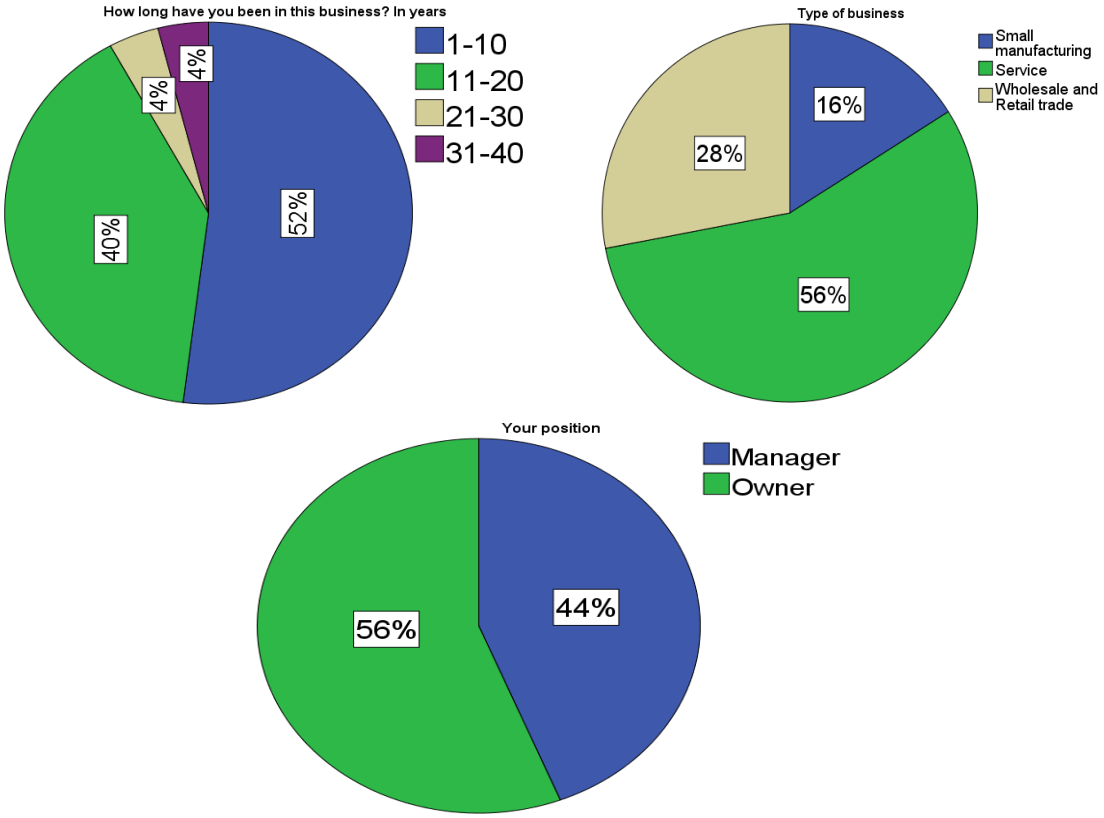
Figure 12: Gender and Age Category



Source: Author's contribution

In addition, the respondents were mostly the owners of the MSMEs (56%) and 44% were managers taking care of the operations of the MSMEs, which are mostly service types of businesses (56%) like salons or barber shops, provision stores, photocopying, and printing shops, etc. Furthermore, 52% of the respondents have at least ten years of business experience and 40% have been in small business for up to twenty years. Moreover, 28% of them are into wholesale and retail types of business and around 16% of them are into small bakery production, fishponds, snacks production, etc. (see Figure 13).

Figure 13: The Business Type, Position, and Experience

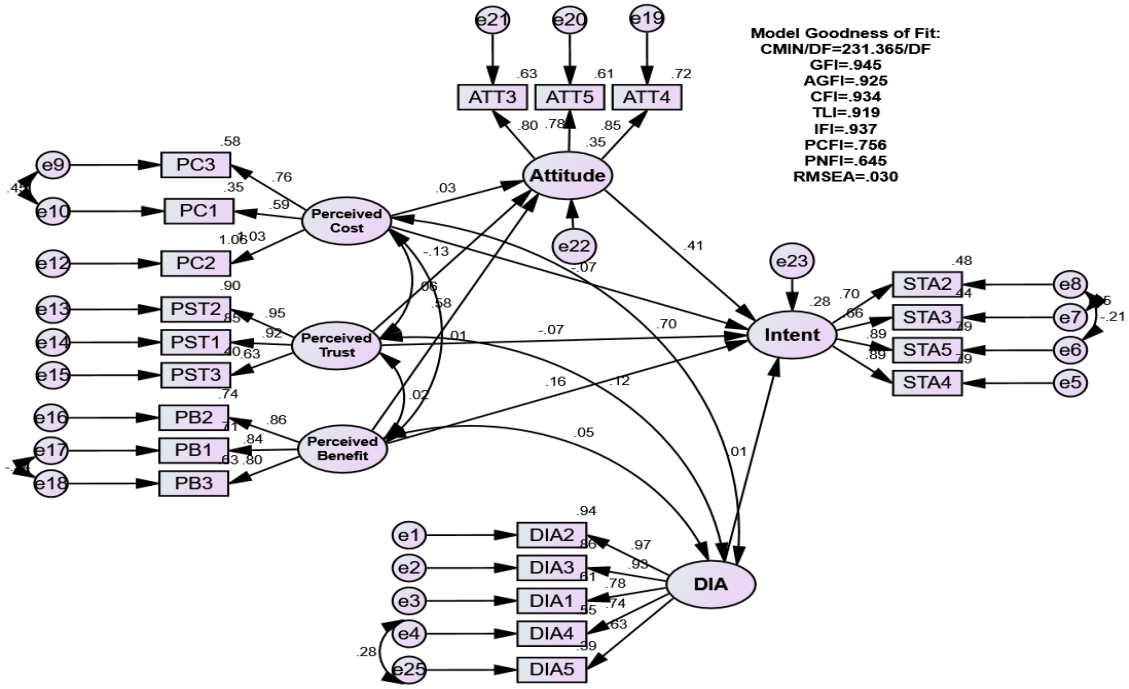


Source: Author's contribution

5.2 Measurement and Structural Models Estimation

After testing the overall goodness of fit for the model, i. e. , the Confirmatory Factor Analysis *(*CFA*)* standardized factor loadings of the observed variables above 0. 5 were retained for further analysis, whereas the observed variables below 0. 5 were dropped. The AVE and CR, as depicted in Figure 10, the model fitness indices, indicated either good or excellent goodness of fit for the data. Graphic Software of AMOS-23 was used to analyse the data and perform the structural equation modelling. Moreover, the structural model estimation validates the relationship between the independent and independent variables of research. As shown in Table 3, apart from the chi- square significant indicator that lacks goodness of fit, which is sensitive to sample size, the model passed the overall goodness of fit based on other criteria. The results showed that the five independent variables explained approximately 28*%* of the variance of solar technology adoption intention *(*see Figure 14*)*. As depicted in Table 4, four hypotheses were statistically significant based on Beta and significance values, and thus, were accepted. However, four other hypotheses were not statistically significant and were rejected.

Figure 14: The Path Analytical Model of the Study



Note: Goodness-of-fit statistics: Relative chi-square= 1.361; GFI=0.945, AGFI=0.925, CFI=0.934, TLI= 0.919, IFI=0.937, PCFI=0.756, PNFI=0.645, RMSEA= 0.030

Source: Extracted from AMOS-23 Output

Table 4: The Summary of Results from the Hypothesis Testing Extracted (AMOS-23)

Hypothesized relationship			Standardized Estimates (β)	Significance	Findings
H_1: Attitude	→	Intention	0.408	***	**Supported**
H_2: Perceived benefits	→	Attitude	0.156	***	**Supported**
H_3: Perceived benefits	→	Intention	0.373	0.043	**Supported**
H_4: Perceived cost	→	Attitude	0.034	0.459	Not Supported
H_5: Perceived cost	→	Intention	-0.067	0.313	Not Supported
H_6: Perceived social trust	→	Attitude	-0.134	0.016	**Supported**
H_7: Perceived social trust	→	Intention	0.067	0.197	Not Supported
H_8: Disruptive innovation activities	→	Intention	0.006	0.936	Not Supported

*Note: Significance of regression weight: † p < 0.100, * p < 0.050, ** p < 0.010, *** p < 0.001 two-tailed*

Source: Extracted from AMOS-23 Output

5.3 Summary of Result

From the data analysis, managers-owners of MSMEs' attitudes influenced their intention to adopt solar technology. Additionally, the potential benefits of solar technology have impacted the attitude and perception of managers-owners of MSMEs, which leads to their willingness to adopt the technology for their business activities. Furthermore, perceived social trust also influences managers-owners of MSMEs' attitude towards solar technology, but does not necessarily lead to adoption intention. However, perceived cost does not negatively influence attitude and intention since the cost of solar might be perceived as being more efficient and reliable when compared with fossil fuel costs, and the cost of maintaining the stand-alone generators for business purposes. The result also indicated that managers-owners of MSMEs' personalities and technological inclination do not influence their intention to adopt solar technology.

6. Discussion

According to the result, $\mathbf{H_1}$ was supported *(*β= 0. 408; p<0. 001*)*, managers-owners' attitudes significantly influence their intention to adopt solar technology. This result supported (e.g, Jorns, 2020; H. Kim et al., 2014; Park & Ohm, 2014) findings**.** It implies that managers-owners have a positive attitude towards solar technology and are willing to adopt it. The results of $\mathbf{H_2}$ **&** $\mathbf{H_3}$ were supported and sustained *(*β= 0. 156 & 0.373; p<0.001*).* These findings are in agreement with those of H. Kim et al. *(*2014*)* and Park and Ohm *(*2014*)*. It means that perceived benefits of the new technology in terms of functionality, independence from the national grid, efficiency, and effectiveness in improving business activities impacted managers-owners' attitudes and perceptions, which might lead to solar technology adoption intention because of the positive mindset toward the technology by managers-owners of MSMEs. However, the results of $\mathbf{H_4}$ **&** $\mathbf{H_5}$ were not statistically significant; hence, they were rejected *(*β= -0. 067 & 0. 156; p<0. 05*)*. This signifies that perceived cost does not negatively influence attitudes and intentions to adopt solar technology**.** In order words, the perceived cost of adopting solar technology to improve business efficiency and effectiveness would not reduce the tendency of managers**-**owners of MSMEs**'** attitudes and intentions**.** As defined in the literature review regarding the differences in cost perception between managers**-**owners of MSMEs and households**'** usage, the result of this study indicated that perceived cost differs in terms of purpose and usage of small businesses and households, which influences solar technology adoption intention**.** On the other hand, the result does not conform to Reddy and Painuly *(*2004*)*, Park and Ohm *(*2014*)*, and Board *(*2020*)***.** As indicated earlier, several reasons might be associated with this**.** For instance, the differences in the unit of analysis**.** Most of the previous studies were conducted on households**'** solar adoption intentions, whereas this study is on manager**-** owners of MSMEs, and the business purpose for adoption differs from households**.** Additionally, the availability of the national grid and the environmental concerns differ in different contexts, so if solar technology is available, accessible, and affordable with government support policy, the initial and maintenance cost would not negatively impact managers**-**owners of MSMEs**'** attitudes and solar technology adoption intention for business activities**.**

Furthermore, the results having a statistically negative significance were accepted *(*β= -0. 134; p<0. 05*)*. This result was confirmed by Loveldy et al. *(*2021*)* and Ha and Janda *(*2012*)*. Nonetheless, the results were not supported *(*β=0**.**067; p<0.05*)* and were not consistent with the results of previous findings *(*e.g., Bollinger & Gillingham, 2012*).* This finding implies that social trust impacts attitude, which means that peers or neighbours might influence a manger's**-** owner's attitude towards solar technology negatively by discouraging them, which leads to an insignificant intention to adopt the technology. Finally, the results were not supported *(*β=0. 006; p<0. 05*)*. It signifies that managers**-**owners of MSMEs are not technologically inclined and do not see the solar system as a disruptive innovative product or as an opportunity to improve their business efficiency, so they tend not to have the intention to adopt solar technology**.** In other words, stand**-**alone fossil fuel generators are still their preferred source of electricity**.** The reason might be the fear of the new technology regarding the durability of solar technology**.** Although a relatively new concept in the literature, this result supported the study of Goodstein and Lovins **(**2019**)**, which suggested that, for economic reasons, solar technology will provide around 50**%** of electric power generation globally by the year

2030 as there is resistance to change from the old source of energy to the new source in the Nigerian context**.** Additionally, the results also supported Osiyevskyy and Dewald **(**2015**)** and Habtay **(**2012**)** findings that technology is not disruptive on its own, but rather the disruptive personality of managers in perceiving the technology as an opportunity or barrier that leads to capturing or not capturing the technology to improve the business model that drives the adoption intention of solar technology**.** In these findings, managers-owners perceive that solar technology has benefits but adopting it is suitable for the long run, which might not have an immediate impact on MSMEs**.** And so, their disruptive innovation activities do not necessarily influence their intention to adopt solar technology**.**

7. Limitations and Future Studies

The result of this study provides insightful evidence that is beneficial for the understanding of the managers-owners of MSMEs' intention to adopt solar technology, and their applications, and provides a considerable issue for future studies related to this field. Nevertheless, this study has some limitations. Firstly, it is difficult to generalize the findings because this is a case study of Anambra State in Nigeria. Consequently, future studies might investigate different states, regions, and countries, particularly in different African nations, for more improved discoveries. Secondly, this study applies a quantitative method with a proposed conceptual model which did not consider some respondent-related factors. Hence, there might be other notable factors that are significantly related to the solar adoption intention omitted from the research model. Thirdly, because this study used data from Anambra State in Nigeria, there are differences in perceptions between states, regions, and other countries. Therefore, more research is needed on solar technology adoption to recommend to stakeholders. Additionally, there is a gap in the literature about the adoption intention of solar in small businesses and what activates the managers-owners' disruptive innovation activities towards solar technology adoption. Therefore, exploring solar technology adoption through the lens of DIA and in different contexts is an area that requires more attention in the literature.

8. Conclusion, Implications, and Recommendations

This study examined the rationale for accepting or rejecting the use of solar technology as an alternative energy source in Nigeria. From a managerial perspective, the result of this study provides support for investment decisions for the managers-owners of MSMEs who are interested in green energy that is environmentally friendly, available, accessible, and affordable as well as for policymakers concerning the improvement of renewable energy policies in Anambra state and Nigeria. To this effect, solar technology (Photovoltaic systems- PV*)* has the capability as a viable energy alternative to mitigate the problem of electricity in Nigeria. The need to highlight the issue of power inadequacies and its impact on small businesses cannot be overemphasized because of the vital role they play in the Nigerian economy. Moreover, around 620 million people have no access to electricity for business or household purposes in Sub-Saharan Africa, according to African Energy Industry Report, 2018[6]. Therefore, the insights gained from this research apply not only to the stakeholders in Nigeria but also to other African countries that are faced with similar power dilemmas.

[6] https://africa-energy-portal.org/reports/african-energy-industry-report-2018 (Accessed 25 January 2022)

Regardless of some limitations, as identified earlier, this research has some important contributions. The significance and contribution of this study do not only strengthen the existing literature on solar technology adoption but also provide policymakers, manufacturers, and suppliers as well as other shareholders with relevant information from MSMEs managers- owners' perspectives for developing renewable energy policies and taking necessary actions to improve power supply for business activities and household usage in Nigeria and other developing countries facing similar energy problems. Hence, government agencies should develop policies that integrate solar technology into the energy master plan and prioritize it because of its ease of use and immediate impact on MSMEs. To promote solar technology as a viable alternative for power shortages, the government and its agencies should raise awareness about renewable energy and communicate the benefits as well as any incentives available to potential adopters if any. Additionally, to make the technology available, accessible, and affordable, the government should promote energy- efficient policies among the manufacturing and installation (suppliers) companies of energy generation that will attract the FDI in Nigeria so that international energy companies like the Thai metropolitan power authority can invest in the energy sector in Nigeria. Table 5 below summarizes the recommendations to the stakeholders.

Table 5: Recommendations on Solar Technology Policy in Nigeria

Source of Energy	**Recommendations for the Government as Stakeholders**
Solar Technology	- From the result, attitude towards behaviour was identified as having an influence on managers- owners of MSMEs' solar technology adoption intentions. Therefore, it is recommended that the government should "open-up" for policy change by creating more avenues through effective renewable policy formulation, implementation, and overall evaluation of the impact of the policy to ensure that the intended goal of the policy is achieved. This will lead to actual adoption of solar technology rather than intent because managers-owners of MSMEs have a positive perception towards the technology. - The perceived benefits were identified as influential to managers-owners of MSMEs' decision to adopt solar technology. Therefore, the government should work with the relevant stakeholders like solar companies (manufacturers, suppliers, and maintenance companies) to make solar technology more available, affordable, and accessible to motivate intention. This would have a vicious cycle impact on the overall Nigerian economy and development towards inclusive and sustainable development. Although the data analysis indicated that perceived cost does not negatively influence manager-owners of MSMEs' adoption intention, high initial and maintenance costs could be a barrier to adoption in the long-run.

Source of Energy	Recommendations for the Government as Stakeholders
Solar Technology	- The government should formulate and implement an effective energy policy with incentives for both small businesses and investors. This will promote and attract small businesses to adopt solar technology as a viable alternative for power to remedy the inadequate power supply in Nigeria as well as attract foreign direct investment in the energy industry. - Although Nigeria's national power grid policy is mainly reserved for the federal government, the Anambra State government can use the result of this research to support her state's MSMEs by providing incentives and soft loans to motivate them to use solar technology for their small business purposes.
	Recommendations for the Businesses
	- The solar technology manufacturing, installation, and supplying companies should create a platform to create more awareness of the technology, particularly the benefits for small businesses because managers-owners have a positive attitude towards solar, but it has not materialized into actual adoption of solar for their business purposes. - Although not directly from this finding of this research, the installation and supplying companies should train qualified installers and electricians that can help facilitate the information sharing that will help spur the positive attitude among managers-owners of MSMEs to actual adoption of the technology. They could provide technical assistance and advice to potential adopters who might have some doubts about the benefits and cost analysis before adoption.

Source: Author's contribution

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