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TRAINING AND RENEWABLE ENERGY ENTREPRENEURSHIP IN NIGERIA

By

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Abstract

Training needs have become a reflection of the growing recognition of renewable energy as a vital sector for economic growth, sustainability, and tackling global energy challenges. This study zeroed in on how training effect renewable energy entrepreneurship in Nigeria. Using a quantitative approach, we gathered data through questionnaires to assess the effect of training on this sector. We employed convenience and purposive sampling techniques to identify a diverse group of stakeholders in renewable energy entrepreneurship, with a total target population of 424 respondents and the employed raosoft calculator of sample to attained a sample size of 202 participants. To analyse the data, we utilized simple regression techniques, analysis of variance (ANOVA), and coefficient analysis, all processed through the Statistical Package for Social Science (SPSS Version 27.0). The findings revealed that training positively affects renewable energy entrepreneurship in Nigeria, with significant impacts from technical, research and development, and policy and regulation training specifically in solar energy, hydropower, and renewable energy consulting. Based on these insights, the study concluded that training is a crucial pillar for the effectiveness and sustainable operation of renewable energy entrepreneurship in Nigeria. It also recommended that training programs should be specifically designed to foster growth in socio-economic and environmental benefits of renewable energy entrepreneurship within Nigeria.

Key Work: *Training, Renewable Energy, Entrepreneurship, Renewable Energy Entrepreneurship*

1.1 Introduction

Training plays a pivotal role in enhancing organizational agility and fostering innovation. It serves as a strategic tool for developing employee competencies, allowing organizations to adapt quickly to changes in their environment. Training equips employees with the knowledge and skills necessary for their current roles, helping to improve their work habits and overall productivity. Within Human Resource Management (HRM), training extends beyond individual learning to encompass company-wide educational initiatives. Particularly in management training, the focus is on developing the leadership capabilities, problem-solving skills, and decision-making abilities of managers. Structured training programs aim to strengthen management skills, cultivate leadership qualities, and promote innovative thinking across operational processes (Jalili, et al., 2025; Bilderback, 2024; Barba-Aragón, & Jiménez-Jiménez, 2024). Furthermore, training has evolved into a critical organizational asset supporting long-term strategic planning, conflict resolution, team building, and performance management (Sult, et al., 2024; Hidayat, & Basuil, 2024). Through such initiatives, managers are empowered to effectively execute their roles and contribute significantly to organizational success. Overall, training offers employees a platform to upgrade their knowledge and skill sets, resulting in improved productivity and enhanced performance across the organization (Iqbal, et al., 2024; Luturmas, et al., 2024; Chigudu, 2025).

Managers who participate in such programs help foster creativity, encourage problem-solving, and promote open communication within their teams. This approach cultivates an environment where new ideas and business opportunities can emerge, fuelling entrepreneurial growth and organizational development (D'Amato, & Hunter, 2024; Maksum, et al., 2024; Ailts Campeau, & Kelly, 2024). A well-executed training strategy aligns managerial efforts with the organization's strategic objectives, leading to greater coordination and synergy across departments. Consequently, investing in comprehensive training programs is essential for improving operational efficiency and sustaining organizational growth in today's competitive business environment.

In the renewable energy sector, entrepreneurship plays a vital role in driving technological innovation and sustainability. Renewable energy entrepreneurship refers to the process of developing, managing, and promoting businesses that provide clean energy solutions. Entrepreneurs in this sector create and market technologies, products, and services designed to reduce reliance on fossil fuels and minimize environmental harm (Dobrovolska, et al., 2024; Bachan, et al., 2024; Zaman, 2025). This industry thrives on the entrepreneurial spirit, where individuals identify opportunities to address global challenges such as climate change and resource depletion (Ahmed, et al., 2024; Eitan, et al., 2020). By developing and deploying renewable energy technologies, entrepreneurs contribute to creating new markets, generating employment, and supporting economic growth.

Globally, investors are increasingly attracted to renewable energy because it offers sustainable and replenishable energy sources like solar, wind, and hydropower. Entrepreneurs in this space explore a wide range of opportunities, including solar power, wind farms, biomass energy, geothermal systems, and hydroelectric projects. Their goals typically involve improving the efficiency and affordability of renewable energy solutions (Uyar, et al., 2024). Entrepreneurs aim to make these innovations accessible and competitive in the marketplace, driving adoption and contributing to sustainability efforts by lowering greenhouse gas emissions, promoting energy independence, and enhancing resilience to climate change (Bathaei, & Štreimikienė, 2023). Successful renewable energy entrepreneurs skilfully navigate regulatory landscapes, secure funding for innovation, and build partnerships with governments, utility companies, and other key stakeholders (Oduro, et al., 2024; Dobrovolska, et al., 2024). Their collective efforts are instrumental in advancing the adoption of clean energy technologies and leading the transition toward a more sustainable energy future.

1.2. Statement of the Problem

Training plays a critical role in shaping renewable energy entrepreneurship, yet several obstacles hinder its effectiveness. In developing countries, particularly Nigeria, access to quality, specialized training in renewable energy technologies and entrepreneurship is limited. This lack of training creates major gaps in technical expertise and business skills needed for success in this field (Streimikiene, et al., 2021; Amir, & Khan, 2022). Additionally, developing and delivering such comprehensive training requires significant financial resources. Unfortunately, many aspiring entrepreneurs struggle to afford these programs, which limits their opportunities to start and sustain renewable energy ventures. A further challenge is that entrepreneurs often lack access to the latest technological innovations, restricting their ability to compete effectively in the renewable energy sector (Rajiani, et al., 2023).

Although various studies have examined how training affects renewable energy entrepreneurship, most have focused on developed countries, leaving a major research gap in developing nations like Nigeria (Bhikraj, et al., 2024; Khezri, & Hasan, 2024; Kuzmin, et al., 2024). Moreover, little attention has been given to specific areas such as solar energy, hydropower, and renewable energy consulting (Khezri, & Hasan, 2024; Willys, et al., 2024; Ahmed, et al., 2024). While training is increasingly seen as vital for promoting sustainable renewable energy entrepreneurship, its actual impact is still unclear (Gunarathna, et al., 2024; Lgseta, 2024). Existing literature presents conflicting results, leaving many strategic questions unanswered. This study seeks to address these gaps by investigating training and renewable energy entrepreneurship in Nigeria, aiming to add meaningful insights to the field.

1.3 Statement of the Hypotheses

Based on the objectives of the study, the following hypotheses were set up to guide the study:

HO_1: Technical raining has no influence on solar energy entrepreneurship in Nigeria.

HO_2: Research and development training has no effect on hydropower entrepreneurship in Nigeria.

HO_3: Policy and regulation training has no effect on renewable energy consulting in Nigeria.

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

2.1 Concept of Training

Training plays a fundamental role in developing the skills, knowledge, and competencies needed by individuals to perform tasks efficiently within an organization. It is a structured process aimed at addressing identified skill gaps to ensure employees can effectively contribute to organizational goals. Essentially, training is a systematic and goal-oriented method designed to enhance performance at the individual, team, and organizational levels. This process is often short-term and practical, focusing on helping non-managerial employees acquire technical know-how and specific abilities relevant to their roles. In organizational settings, training involves learning programmed behaviours and applying knowledge in ways that improve an employee's current performance and prepare them for future responsibilities. Aligning training with strategic goals, utilizing diverse delivery methods, and evaluating its impact helps organizations drive growth and success (Ailts Campeau, & Kelly, 2024).

The broader purpose of training goes beyond skill enhancement; it empowers individuals, making them competent and confident both professionally and personally (Hosen, et al., 2024). Training shapes behaviour positively to contribute to organizational progress and performance improvement (Shanmugathasan, & Thirunavukkarasu, 2024). Viewed as a key tool of Human Resource Development (HRD), training supports various initiatives such as leadership development, team organization, entrepreneurship promotion, and resource mobilization, especially in communities with limited means. Moreover, it plays a critical role in transferring the latest technical knowledge to rural populations, forming self-help groups, and equipping people with skills to foster sustainable livelihoods (Fitriyani, et al., 2024; Bilderback, 2024; Iddrisu, & Adam, 2024). Strategically, well-designed training initiatives enhance organizational innovation and technological adoption in operational processes (Stojcic, 2024; Viterouli, et al., 2024). Ultimately, training fuels both individual and organizational transformation.

Despite its importance, training efforts in many organizations encounter numerous challenges. Financial constraints often limit the scope and quality of training programs, resulting in incomplete or ineffective sessions (Pietrołaj, & Blok, 2024). Moreover, some organizations struggle to accurately identify the essential skills or knowledge gaps among employees. This misalignment leads to poorly targeted training that fails to address the core developmental needs of staff (Sidhu, et al., 2024; Bocock, & Del Pozo, 2024). Additionally, a lack of modern training tools such as e-learning platforms, simulations, and up-to-date materials further undermines the effectiveness of training programs. Organizations operating in remote areas may face infrastructural limitations that restrict access to quality learning opportunities. Furthermore, when management fails to actively support or participate in training initiatives, employees are likely to undervalue them. Without leadership commitment, training efforts often lose direction, resulting in fragmented and ineffective outcomes (Prakapienė. & Markelienė, 2024; Yang, et al., 2024). The indicators of training in this study are:

Technical Training: Technical training equips individuals with practical skills and knowledge necessary to design, install, operate, and maintain renewable energy systems. This includes hands-on experience in managing energy sources such as solar, wind, hydro, biomass, and geothermal power. Participants learn the technical principles behind photovoltaic systems, wind turbines, hydroelectric plants, and other renewable technologies (Abd Majid, et al., 2024). Practical sessions ensure that trainees can apply these concepts in real-world situations through system installations, troubleshooting, and maintenance tasks (Brown, & De Neve, 2024). The training also covers safety protocols, especially when working with electrical systems or hazardous equipment, like those involved in wind energy (Gong, et al., 2024). Well-trained technical professionals are essential for expanding the renewable energy sector, creating jobs, and driving economic development. By closing the technical skills gap, this form of training supports the global shift away from fossil fuels, promoting sustainability and energy independence (Daoudi, 2024).

Research and Development Training: Research and Development training in renewable energy focuses on fostering innovation and optimizing technologies. R&D is crucial for addressing technical, environmental, and economic challenges within the renewable energy field. Participants are encouraged to develop new solutions or improve existing technologies, such as enhancing solar panel materials, refining wind turbine designs, or advancing energy storage systems like batteries (Nguyen-Van, & Chang, 2024). Sustainability is a major focus in R&D training, which emphasizes reducing environmental impact, minimizing waste, and optimizing resource use (Bilderback, 2024). Collaboration is another key aspect, as renewable energy research thrives on partnerships between academic institutions, industries, and government agencies. Through networking and resource-sharing, R&D training accelerates the development of more efficient and cost-effective renewable energy solutions (Li, et al., 2023). Overall, this training supports the global energy transition toward greener systems.

Policy and Regulation Training: Policy and Regulation Training, which ensures that stakeholders understand the legal and regulatory frameworks governing renewable energy. This training empowers individuals and organizations to comply with relevant policies, promoting responsible and sustainable energy development. Participants learn about national and international policies, renewable energy targets, incentive programs, and governmental strategies designed to support clean energy adoption (Hinterleitner, et al., 2024). They are also trained on compliance requirements, such as safety standards, environmental assessments, and grid integration rules, which are essential for the successful deployment of renewable energy projects (Comunale, & Manera, 2024). Additionally, the training covers processes for securing necessary permits and licenses for renewable energy installations. Understanding the roles of local, national, and international regulatory bodies helps ensure smooth project implementation. Environmental regulations aimed at reducing carbon emissions and promoting sustainability are also addressed, guiding businesses to align their operations with international standards, such as those set by the United Nations Framework Convention on Climate Change (UNFCCC) (Ragusa, & Crampton, 2024). Policy and Regulation Training is crucial for a wide range of professionals, including policymakers, project developers, financiers, legal experts, and environmental consultants (Onuh, et al., 2024; Ekung, & Opoku, 2024).

2.2 Concept of Renewable Energy

Renewable energy is the generation of energy from natural sources that replenish themselves over time. These resources include sunlight, wind, rainfall, tides, ocean waves, and geothermal heat from beneath the earth's surface. Unlike fossil fuels such as coal, oil, and gas which take millions of years to form and are gradually depleting renewable energy sources are sustainable and eco-friendly. They play a crucial role in reducing pollution and lowering greenhouse gas emissions, which are major contributors to climate change. Renewable energy sources are not only naturally replenished but also widely available across the globe, making them vital for the future of clean energy. Investing in renewable energy technologies has created countless jobs and driven technological progress. Key technologies include solar power, wind turbines, hydroelectric dams, geothermal systems, and biomass energy. In recent years, these technologies have seen major improvements in terms of efficiency, affordability, and adaptability to existing energy systems.

Solar energy, for example, has benefited from innovations that increase the efficiency of solar panels and enhance energy storage capabilities, allowing for more reliable power even when the sun isn't shining (Elalfy, et al., 2024). Wind energy has also evolved with better turbine designs and offshore wind farms, improving energy generation (Gupta, 2024). To encourage the widespread adoption of these technologies, governments across the world have introduced supportive policies. These include financial incentives like feed-in tariffs, tax breaks, and subsidies, which make renewable energy more financially attractive. In Nigeria, the Renewable Energy Master Plan (REMP) has highlighted the importance of investing in solar and biomass energy to extend electricity access to rural areas where the national grid has not reached (Obada, et al., 2024). Similarly, the European Union's Green Deal has outlined ambitious goals to cut carbon emissions significantly by increasing the reliance on renewable energy sources (Gajdzik, et al., 2024).

Beyond the environmental advantages, renewable energy contributes greatly to economic growth. It generates employment opportunities, supports regional economic development, and can help reduce poverty. In Nigeria, renewable energy projects have the potential to electrify remote communities, boosting local businesses and improving living standards (Adelaja, 2020). However, despite these advantages, several challenges hinder the widespread adoption of renewable energy, especially in developing countries. High upfront costs and a shortage of technical expertise continue to pose obstacles (Makepa, & Chihobo, 2024). Moreover, while renewable energy reduces emissions, the manufacturing and disposal of renewable technologies such as solar panels and batteries can still have environmental consequences. Another technical challenge is intermittency—the fact that resources like sunlight and wind are not constant. This makes energy storage solutions critical for ensuring a steady supply of power. Current research efforts are focused on developing better storage technologies, such as hydrogen fuel cells and advanced battery systems, to address these limitations (Wei, et al., 2023; Sayed, et al., 2023). Moving forward, renewable energy systems are expected to become more integrated with digital technologies like artificial intelligence to optimize energy production, storage, and consumption (Bassey, et al., 2024; Rusilowati, et al., 2024; Fan, et al., 2023).

2.3 Concept of Renewable Energy Entrepreneurship

Renewable energy entrepreneurship involves creating and managing businesses that develop, distribute, or utilize renewable energy technologies. This form of entrepreneurship focuses on innovation, sustainability, and responding to the market's demand for cleaner energy solutions. Growing concerns over climate change and the need to cut carbon emissions have created fertile ground for renewable energy entrepreneurs (Żuk, & Żuk, 2021). Supportive government policies and incentives have further encouraged entrepreneurial activities in this sector (Dobrovolska, et al., 2024; Diaconescu, et al., 2024). Businesses in the renewable energy field often create jobs in manufacturing, installation, and maintenance (Wysocka, 2023; Cappa, et al., 2024). Additionally, by reducing reliance on imported fossil fuels, renewable energy ventures enhance energy security and support economic independence.

Renewable energy entrepreneurship not only supports economic growth but also aligns with global sustainable development goals. It provides cleaner energy options and reduces environmental degradation (Bhikraj, et al., 2024; Dobrovolska et al., 2024). Several factors drive the success of renewable energy entrepreneurs, including favourable regulations, financial incentives, and a growing demand for innovative solutions such as smart grids and energy storage systems (Alka, et al., 2025). Entrepreneurs in this field play a pivotal role in addressing global energy challenges and driving the transition to sustainable energy. Their innovative business models and products contribute meaningfully to climate change mitigation and economic development (Romero-Castro, et al., 2022; Chou, et al., 2023). The following are the indicators of renewable energy entrepreneurship that this study had adopted:

***Solar Energy Entrepreneurship*:** Solar energy entrepreneurship refers to starting and managing businesses focused on developing and commercializing solar energy solutions. This field blends entrepreneurial skills with technological innovation in solar power, emphasizing sustainable business models that support energy transition efforts. Solar energy remains one of the fastest-growing segments of renewable energy (Kakran, et al., 2024). Entrepreneurs in this sector develop business models such as leasing solar systems, offering power purchase agreements (PPAs), and establishing community solar projects to make solar energy accessible to a wider range of consumers (Strupeit, et al., 2024). Innovators in solar energy continuously work on enhancing photovoltaic technologies, developing energy storage systems, and integrating smart grid solutions to improve energy efficiency and cost-effectiveness (Obaideen, et al., 2023). The success of solar ventures largely depends on government incentives, supportive regulatory frameworks, and public-private partnerships (Nguyen, et al., 2022). Solar entrepreneurs also play a role in social transformation by bringing affordable and reliable electricity to underserved communities, fostering social and economic inclusion (Baquero, & Monsalve, 2024). Overall, solar entrepreneurship represents a vital pathway toward innovation, sustainability, and economic resilience.

***Hydropower Entrepreneurship*:** Hydropower entrepreneurship involves starting businesses that focus on producing and distributing energy from water sources. Entrepreneurs in this sector are responsible for securing funding, conducting technical and environmental feasibility studies, and navigating complex regulatory landscapes (Rospriandana, et al., 2023). Some entrepreneurs specialize in developing small-scale hydropower projects, particularly useful for rural or remote communities where large-scale infrastructure is impractical (Adeyeye, et al., 2021). Others work on integrating hydropower with other renewables such as solar and wind, creating hybrid energy systems that provide a more reliable power supply. Advances in technology have also enabled entrepreneurs to improve energy management and distribution from hydropower sources (Kiasari, et al., 2024). Hydropower entrepreneurship presents a significant opportunity for sustainable energy development, balancing environmental protection with economic benefits (Constant, et al., 2021; Peters, et al., 2024; Dobrovolska, et al., 2024).

***Renewable Energy Consulting*:** renewable energy consulting is an essential component of this entrepreneurial ecosystem. Renewable energy consulting involves offering professional advice on project development, technology choices, policy compliance, and market strategies. Consultants help businesses and governments understand the demand for renewable energy in various sectors whether residential, commercial, or industrial (Panny, et al., 2024). They also analyse policy environments, tax incentives, and environmental regulations that influence renewable energy deployment. Consultants evaluate system performance, benchmark efficiency, and guide strategic planning to optimize energy projects (Gitelman, et al., 2020). By providing these insights, renewable energy consultants accelerate the adoption of sustainable energy technologies and help organizations navigate the complexities of the clean energy transition (Milder, 2024).

2.4 Effect of Training on Renewable Energy Entrepreneurship

The shift towards renewable energy is essential for achieving sustainable development and tackling climate change challenges. Entrepreneurs in this sector play a key role by driving innovation, creating employment opportunities, and supporting energy independence. However, their success largely depends on how well they are trained to manage the technical and business aspects of renewable energy ventures. Training programs are crucial in helping entrepreneurs develop the necessary skills and knowledge for the renewable energy industry (Amalu, et al., 2023). These programs offer insights into emerging technologies, market trends, regulatory requirements, and essential business management practices that are vital for starting and sustaining renewable energy enterprises. Additionally, such training helps entrepreneurs improve their technical abilities, such as the installation and maintenance of renewable energy systems, as well as important business skills like financial management and marketing (Arueyingho, et al., 2023). A well-rounded skillset allows them to better navigate the complexities of the renewable energy market. Moreover, training initiatives often create platforms where entrepreneurs can network with industry experts, investors, and peers, fostering collaborations, mentorship, and access to funding, which are critical for business growth. Understanding regulatory frameworks and sustainability practices is another vital aspect of training (Dobrovolska, et al., 2024). Entrepreneurs gain the ability to assess the environmental and social impacts of their projects, which enhances their credibility with investors who prioritize social responsibility. Ultimately, effective training promotes innovation, enhances entrepreneurial capacity, and builds strong industry networks. For these benefits to be fully realized, training programs should be accessible, affordable, and tailored to the unique needs of renewable energy entrepreneurs.

2.5 Theoretical Framework

The training and renewable energy entrepreneurship can be explored through various theoretical frameworks that examine the relationship between education, skill development, and entrepreneurial success.
Human Capital Theory (HCT): This theory posits that investment in education and training enhances an individual's skills and knowledge, which in turn increases their productivity and earning potential. Human Capital Theory is an economic theory that views individuals as repositories of skills, knowledge, and experience, which can be enhanced through education, training, and other investments (Grigorescu, et al., 2021). The theory posits that these attributes constitute a form of capital that can increase productivity and economic value, similar to physical capital like machinery or equipment (Luo, & Qiao, 2024). HCT emphasizes that investing in education and skill development is essential for improving an individual's productivity and, consequently, their income potential. It suggests that the more an individual invests in their education and skills, the greater their earning potential and career opportunities. In the context of renewable energy entrepreneurship, training can equip entrepreneurs with the technical skills and business acumen necessary to innovate and compete in the renewable energy sector.

Innovation Diffusion Theory (IDT): Proposed by Everett Rogers, this theory examines how new ideas and technologies spread within and between cultures. Innovation Diffusion Theory is a framework that seeks to explain how, why, and at what rate new ideas and technology spread among individuals, groups, or organizations (Takahashi, et al., 2024). IDT provides valuable insights into the dynamics of innovation adoption and highlights the importance of social context in the diffusion process (Sehgal, & Jain, 2024). By understanding these concepts, organizations and policymakers can better facilitate the spread of beneficial innovations within their target populations. Training programs can facilitate the diffusion of renewable energy technologies by educating entrepreneurs about their benefits and practical applications, thus fostering innovation in the field.

2.6 Empirical Review

The study by Daoudi, (2024) investigates the crucial role of education in Morocco's renewable energy transition, which aligns with the country's 2030 energy goals. Using both qualitative thematic analysis and quantitative survey methods, the research examines how renewable energy education impacts the Sustainable Development Goals (SDGs). A survey was conducted among 1,323 higher education students from various scientific disciplines such as physical, chemical, mathematical, life, earth sciences, and computer science. The study highlights the importance of pedagogical approaches, learning tools, and the training of educators in renewable energy fields. It also emphasizes the role of community engagement and public awareness in supporting the renewable energy transition. Furthermore, the research discusses the current contributions of renewable energy education to Morocco's SDG achievements and outlines future opportunities for improving the sector. Ultimately, the study offers valuable insights aimed at enhancing renewable energy education and promoting sustainable development in Morocco.

Similarly, Amalu, et al. (2023) focused on the critical skill gaps and challenges facing STEM and STEAM graduates aiming for employability and entrepreneurship in the solar energy sector. The study highlights that photovoltaic module (PVM) are essential for achieving the United Nations Sustainable Development Goal 7 (SDG-7) and the Net-Zero targets by 2050. However, a shortage of skilled labour in Solar Energy Technology (SET) poses a major obstacle to the sector's growth, particularly within the European Union (EU). Through literature reviews, interviews, and observations, the study identifies the essential academic, industrial, and entrepreneurial skills needed in the solar energy sector. It stresses the mismatch between available skills and industry needs and recommends integrating specialized solar technology skills into higher education curricula. By adopting Solar Energy Technology Training (SETechTra) modules, educational institutions can better prepare graduates for careers in the sector, bridging the existing skills gap and supporting the sustainability of the solar energy industry.

METHODOLOGY

3.1 Research Designs

The study used the study employed descriptive survey research design in the examination of the impact of training on renewable energy entrepreneurship in Nigeria. The choice of this method is justified by the fact that it enabled the researchers provide accurate and detailed portrayal of the phenomenon under investigation by focusing on describing the characteristics or attributes of what is being studied.

3.2 Sampling Techniques and Population of the Study

The target population for this study were the entire stakeholders in training, renewable energy experts and renewable energy entrepreneurship. The population selected was designed to obtain adequate and diverse views pertaining to the impact of training on renewable energy entrepreneurship in Nigeria. The study used non-probability sampling techniques to determine the population of the study. In this study examining the effect of training on renewable energy entrepreneurship, convenience and purposive sampling techniques was used to determine the population due to the challenging to gather data from all entrepreneurs in the sector due to factors like geographic dispersion or the small number of relevant experts. And because it was critical to include participants who have undergone training in renewable energy entrepreneurship or have extensive experience in the field.

Table 3.1 Population Frame

S/N	Stakeholders	Population
1.	Existing Entrepreneurs in Renewable Energy	118
2.	Renewable Energy Professionals	116
3.	Technical and Vocational Trainees	85
4.	Government and NGO Employees	105
	Total	**424**

Researcher's Computation (2025)

3.3 Sample Size Determination

In this study, the researchers used raosoft calculator to the determined the sample size of 202. The use of the Raosoft sample size calculator to determine a sample of 202 respondents from a total population of 424 in the study on training and renewable energy entrepreneurship in Nigeria is justified because it ensures statistical reliability and representativeness. The calculator applies scientific principles by considering key parameters such as population size, margin of error, confidence level, and response distribution. This approach helps achieve a balance between accuracy and feasibility, ensuring that the selected sample reflects the views of the entire population without being too large or too small. Thus, using Raosoft enhances the validity and generalizability of the study's findings.

3.4 Sources of Data Collection

Primary data was sourced directly from the selected sample size of the prospective respondents through a structured, closed-ended questionnaire that was adequately and efficiently administered by the researcher and other experts in the field of the training and renewable energy entrepreneurship. The secondary data were used to carried out conceptual, empirical reviewed and theoretical framework on training and its variables as well as renewable energy entrepreneurship and its accompanied variables in this study.

3.5 Methods of Data Collection

The study employed closed-ended structured questionnaire as instrument for data collection from the stakeholders of training and renewable energy entrepreneurship. The questionnaire was designed on a five-point Likert scale such as "strongly agreed," "agreed," "undecided," "disagreed," and "strongly disagreed." The questionnaire was be adequately administered by experts and academicians in the field of study to meet the expected result from the study on training and renewable energy entrepreneurship stakeholders. Therefore, the study distributed 202 copies of the questionnaire administered to the sampled respondents of renewable entrepreneurship stakeholders, through their Administrative and Human Resource Departments. The questionnaire for the respondents was structured based on the two main variables identified and sub-variables in the study and 194 was returned correctly filled and 8 were not filled correctly.

3.6 Validity and Reliability of Research Instruments

To ensure the credibility of the study, content validity was applied by carefully developing the questionnaire items based on the research objectives, questions, and hypotheses. These items were critically reviewed and evaluated by experts, practitioners, and scholars in the fields of training and renewable energy entrepreneurship within an academic setting. The use of questionnaires and items of both variables in similar fields has been widely accepted in past studies, consistently producing reliable findings and meaningful conclusions (Amir & Khan, 2022; Baquero & Monsalve, 2024; Bhikraj et al., 2024). In this study, the questionnaire underwent thorough content validity and reliability testing to confirm its ability to accurately address the research questions and generate valid data.

3.8 Methods of Data Analysis

For the analysis of the collected data, the researcher adopted both descriptive and inferential statistical methods. Tools such as percentages and tables were used to present data, while statistical inference techniques helped examine the relationship between the study variables. Using SPSS Version 27.0, the researcher applied simple regression analysis, analysis of variance (ANOVA), and coefficient analysis to test the hypotheses. Simple regression helped explain the relationship between the independent and dependent variables, while ANOVA was employed to compare the means of different groups for significant differences. Coefficient analysis further assessed the strength and direction of the linear relationship between the variables, ensuring robust and meaningful interpretations.

3.10 Model Specification

The study's variables have a structural model that addresses the two main variables in the study, which are the independent and dependent variables. The independent variable was Training (TR) which had indicators of Technical Training (TT), Research and Development Training (RDT) and Policy and Regulatory Training (PRT). The dependent variable was Renewable Energy Entrepreneurship (REE) that proxies Solar Energy Entrepreneurship (SEE), Hydropower Entrepreneurship (HE) and Renewable Energy Consulting (REC). As a result, in this model, Training evaluation is the functionality that is driven by the strengths and sustainability of Renewable Energy Entrepreneurship.

REE= $\beta o + \beta_1 TT + \beta_1 RDT + \beta_1 PRT + e$……………………………………………………………(i)
SEE= $\beta o + \beta_1 TT + \beta_1 RDT + \beta_1 PRT + e$……………………………………………………………(ii)
HE= $\beta o + \beta_1 TT + \beta_1 RDT + \beta_1 PRT + e$……………………………………………………………(iii)
REC= $\beta o + \beta_1 TT + \beta_1 RDT + \beta_1 PRT + e$…………………………………………………………..(iv)

Were,

β = Beta Coefficient of the parameter or the explanatory variables

βo= Intercept

e= Error Term

DATA ANALYSIS AND DISCUSSION OF FINDINGS

4.1Testing of hypothesis one

HO₁: Technical raining has no influence on solar energy entrepreneurship in Nigeria.

$SEE= \beta o + \beta_1 TT+ \beta_1 RDT + \beta_1 PRT + e$……………………………………………………(ii)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.568[a]	.323	.319	.43540

a. Predictors: (Constant), TT

The model summary showed that the correlation coefficient (**R = 0.568**) indicates a **moderate positive relationship** between technical training and solar energy entrepreneurship in Nigeria. The **R Square value of 0.323** implies that approximately **32.3% of the variation** in solar energy entrepreneurship can be explained by technical training. The **Adjusted R Square (0.319)** adjusts for the number of predictors in the model, confirming that technical training remains a meaningful factor, even after accounting for model complexity. The standard error of 0.43540 suggests that the model's predictions moderately deviate from the observed data, which is typical in social science research. The results suggested that technical training contributes significantly to the development of solar energy entrepreneurship in Nigeria**,** accounting for about one-third of the variation in entrepreneurial performance within the sector. Thus, the null hypothesis (that technical training has no influence) is likely to be rejected based on these findings.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	18.060	1	18.060	95.267	.000[b]
	Residual	37.915	200	.190		
	Total	55.975	201			

a. Dependent Variable: SEE

The ANOVA results revealed that the regression sum of squares (18.060) accounts for a significant proportion of the total variation (55.975) in solar energy entrepreneurship. The computed **F-statistic of 95.267** with a corresponding **p-value of 0.000** indicates that the model is statistically significant at the 0.05 level. This means that the probability of obtaining such an F-value by random chance is extremely low (less than 0.05). Consequently, the null hypothesis (HO_1), which states that technical training has no significant influence on solar energy entrepreneurship in Nigeria, is **rejected**. In conclusion, the findings demonstrated that technical training exerts a significant positive influence on solar energy entrepreneurship in Nigeria. This suggests that entrepreneurs who receive appropriate technical training are more likely to engage effectively in solar energy ventures and enhance their business performance.

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	2.165	.219		9.869	.000
	TT	.540	.055	.568	9.760	.000

a. Dependent Variable: SEE

The regression results presented above revealed that the constant (intercept) has a value of **2.165**, indicating the expected level of solar energy entrepreneurship (SEE) when technical training (TT) is not considered. The **unstandardized coefficient (B = 0.540)** suggests that a one-unit increase in technical training leads to a **0.540-unit increase** in solar energy entrepreneurship, holding other factors constant. Furthermore, the **standardized coefficient (Beta = 0.568)** demonstrates that technical training exerts a relatively strong positive influence on solar energy entrepreneurship. The **t-statistic (t = 9.760)**, coupled with a **significance value (p = 0.000)**, confirms that this relationship is statistically significant at the 5% level. Since the p-value is less than 0.05, the null hypothesis (HO1) is rejected. The findings therefore indicated that technical training has a significant and positive effect on solar energy entrepreneurship in Nigeria**.** This implies that improvements in technical training enhance entrepreneurs' knowledge, competence, and ability to operate effectively within the solar energy sector. Consequently, capacity-building initiatives focused on technical skills are crucial for fostering the growth and sustainability of solar energy entrepreneurship in the country.

Testing of hypothesis two

HO_2: Research and Development training has no significant effect on hydropower entrepreneurship in Nigeria.

$HE = \beta o + \beta_1 TT + \beta_1 RDT + \beta_1 PRT + e$……………………………………………………………(iii)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.802[a]	.644	.642	.31016

a. Predictors: (Constant), RDT

The model summary results demonstrated a strong positive correlation (**R = 0.802**) between research and development training and hydropower entrepreneurship in Nigeria. This suggests that improvements in research and development training are closely associated with an increase in entrepreneurial activities within the hydropower sector. The coefficient of determination (**R^2 = 0.644**) indicates that approximately **64.4%** of the variance in hydropower entrepreneurship can be explained by research and development training. This implies that R&D training plays a substantial role in shaping entrepreneurial engagement in the hydropower industry, while the remaining 35.6% of the variation is attributable to other unobserved factors.

The adjusted R^2 value (**0.642**) further supports the robustness of the model, indicating only a minimal reduction after accounting for the number of predictors. The standard error of the estimate (**0.31016**) shows that the model predicts outcomes with relatively low error, signifying a high level of accuracy in the regression analysis. Based on these results, the null hypothesis (H_{02}), which posits that research and development training has no significant effect on hydropower entrepreneurship, is not supported. Therefore, the study concluded that research and development training exert a significant and positive effect on hydropower entrepreneurship in Nigeria. This finding underscores the importance of continuous investment in R&D initiatives to enhance innovation, technological advancement, and entrepreneurial performance within the hydropower sector.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	34.756	1	34.756	361.301	.000[b]
	Residual	19.239	200	.096		
	Total	53.995	201			

a. Dependent Variable: HE

b. Predictors: (Constant), RDT

The ANOVA results indicated that the regression model is statistically significant, with an **F-value of 361.301** and a **p-value of 0.000**, which is **below the 0.05 threshold**. This means that the model explains a significant portion of the variance in hydropower entrepreneurship. Consequently, the null hypothesis (HO_2), which proposes that Research and Development training has no significant effect on hydropower entrepreneurship in Nigeria, is **rejected**. This finding implies that R&D training plays a critical role in promoting hydropower entrepreneurship within the Nigerian context. Enhanced training in research and development equips entrepreneurs with the necessary skills and innovative capacity to improve operational efficiency, develop sustainable technologies, and expand business opportunities in the hydropower sector.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.260	.147		8.594	.000
	RDT	.693	.036	.802	19.008	.000

a. Dependent Variable: HE

The regression results revealed that Research and Development training (RDT) has a **significant positive influence** on hydropower entrepreneurship (HE). The unstandardized coefficient value (**B = 0.693**) indicates that a one-unit increase in R&D training leads to an approximate **0.693-unit increase** in hydropower entrepreneurship, holding other factors constant.

The **t-statistic (19.008)** is considerably higher than the critical value, with a corresponding **p-value of 0.000**, which is well below the 0.05 threshold for statistical significance. This implies that the effect of R&D training on hydropower entrepreneurship is not due to random chance. The standardized beta coefficient (**β = 0.802**) also demonstrates a strong and positive relationship, suggesting that R&D training is a major predictor of entrepreneurial performance in the hydropower sector. Given the statistically significant p-value, the null hypothesis (HO_2) — which posited that R&D training has no significant effect on hydropower entrepreneurship — is **rejected**. Therefore, the study concludes that R&D training exerts a substantial and positive effect on the growth of hydropower entrepreneurship in Nigeria. This finding highlights the importance of continuous investment in research and development initiatives to foster innovation, technical expertise, and business growth within the hydropower sector. Strengthening R&D capacity can enhance entrepreneurs' ability to adopt new technologies, improve operational efficiency, and contribute to sustainable energy development in Nigeria.

Testing of hypothesis three

HO_3: Policy and Regulation training has no effect on renewable energy consulting in Nigeria.

$REC = \beta o + \beta_1 TT + \beta_1 RDT + \beta_1 PRT + e$……………………………………………………..(iv)

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.739[a]	.547	.545	.34538

a. Predictors: (Constant), PRT

The model summary indicated a **correlation coefficient (R)** of **0.739**, showing a strong positive relationship between Policy and Regulation Training and Renewable Energy Consulting in Nigeria. The **R Square value (0.547)** suggests that approximately **54.7%** of the variation in renewable energy consulting can be explained by policy and regulation training. The **Adjusted R Square (0.545)**, which adjusts for the number of predictors, confirms that about **54.5%** of the variation in renewable energy consulting is accounted for by the model. This indicates that the model is reliable and provides a good fit for the data. The **Standard Error of the Estimate (0.34538)** further demonstrates that the model predicts renewable energy consulting outcomes with a reasonable degree of accuracy, given the small margin of error.

The findings implied that training related to energy policies and regulatory frameworks plays a substantial role in enhancing renewable energy consulting practices in Nigeria. This strong relationship indicates that professionals who undergo policy and regulation training are better equipped to provide effective consultancy services within the renewable energy sector. Given the strength of the correlation and the proportion of variance explained by the model, the null hypothesis (HO_3), which posits that *policy and regulation training has no effect on renewable energy consulting in Nigeria*, is **rejected**. Therefore, it can be concluded that policy and regulation training significantly effect on renewable energy consulting in Nigeria.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	28.788	1	28.788	241.333	.000[b]
	Residual	23.857	200	.119		
	Total	52.645	201			

a. Dependent Variable: REC

b. Predictors: (Constant), PRT

The analysis of variance (ANOVA) was conducted to examine the effect of Policy and Regulation Training (PRT) on Renewable Energy Consulting (REC) in Nigeria. The results, as presented in the table, indicated that the regression model produced a sum of squares of 28.788, while the residual sum of squares was 23.857, bringing the total to 52.645. The calculated F-value of 241.333 with a corresponding significance level (Sig.) of 0.000 suggested that the model is statistically significant at the 5% level. This implies that Policy and Regulation Training contributes meaningfully to variations observed in Renewable Energy Consulting. Consequently, since the p-value is less than 0.05, the null hypothesis (H_{03}), which posited that Policy and Regulation Training has no effect on Renewable Energy Consulting in Nigeria, is rejected. Therefore, it can be concluded that Policy and

Regulation Training exerts a significant and positive influence on Renewable Energy Consulting within the Nigerian context.

Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	1.503	.164		9.146	.000
	PRT	.633	.041	.739	15.535	.000

a. Dependent Variable: REC

The regression analysis produced the following key statistics:

- **Constant (Intercept):** 1.503
  This indicates that when the effect of Policy and Regulation Training (PRT) is held constant (i.e., PRT = 0), the baseline level of Renewable Energy Consulting (REC) is 1.503 units.
- **Unstandardized Coefficient (B) for PRT:** 0.633
  This suggests that for every one-unit increase in Policy and Regulation Training, Renewable Energy Consulting increases by 0.633 units. This shows a positive relationship between the two variables.
- **Standardized Coefficient (Beta):** 0.739
  This value reflects the strength of the relationship between PRT and REC when all variables are standardized. A Beta of 0.739 indicates a strong positive effect.
- **t-value:** 15.535
  The t-statistic is much higher than the critical value (typically around ±1.96 for a 5% significance level), suggesting that the relationship is statistically significant.
- **Significance level (Sig.):** 0.000
  Since the p-value is less than 0.05, the null hypothesis (HO_3) is rejected. This means that Policy and Regulation Training has a **significant positive effect** on Renewable Energy Consulting in Nigeria.

The constant term (1.503) indicates the baseline level of Renewable Energy Consulting when Policy and Regulation Training is absent. This suggests that even without training, a minimal level of consulting activity exists, possibly due to other influencing factors within the sector. The unstandardized coefficient for Policy and Regulation Training (B = 0.633) reveals that a one-unit increase in PRT leads to a 0.633-unit rise in Renewable Energy Consulting. This positive coefficient demonstrates a direct and beneficial relationship between the two variables. Furthermore, the standardized coefficient (Beta =0.739) indicated that Policy and Regulation Training exerts a strong positive influence on Renewable Energy Consulting. This implies that variations in PRT account for a substantial proportion of changes observed in REC. The t-statistic (t = 15.535) and its corresponding significance value (p = 0.000) are well above and below the conventional thresholds ($|t| > 1.96$ and $p < 0.05$), respectively. This confirms that the relationship between Policy and Regulation Training and Renewable Energy Consulting is statistically significant. Given that the p-value (0.000) is less than the 0.05 level of significance, the null hypothesis (H_{03}) is **rejected**. It is therefore concluded that Policy and Regulation Training has a **significant positive effect** on Renewable Energy Consulting in Nigeria. The findings indicated that enhancing policy and regulatory training among consultants significantly strengthens the renewable energy consulting sector in Nigeria. This suggested that equipping professionals with adequate policy knowledge and regulatory understanding enhances their capacity to provide effective consultancy services, thereby supporting the development and sustainability of the renewable energy industry.

4.2 Discussion of Findings

The study revealed that there was impact of training on renewable energy entrepreneurship in Nigeria. This finding also showed that training had significance impact on on renewable energy entrepreneurship in terms solar renewable entrepreneurship, hydropower entrepreneurship and renewable energy consulting in Nigeria. This finding is in line with previous studies conceptually, empirically and theoretically that training had effect and impact on renewable energy entrepreneurship practice performance and sustainability (Amalu, et al., 2023; Arueyingho, et al., 2023; Dobrovolska, et al., 2024; Wysocka, 2023; Cappa, et al., 2024; Romero-Castro, et al. 2022; Chou, et al., 2023; Bhikraj et al., 2024; Khezri & Hasan, 2024; Kuzmin et al., 2024). The study finding was also supported by the theoretical framework of Human Capital Theory, Resource-Based View and Innovation Diffusion Theory that training had significance impact on renewable energy entrepreneurship in terms solar renewable entrepreneurship, hydropower entrepreneurship and renewable energy consulting in Nigeria.

The study revealed that technical raining had effect on solar energy entrepreneurship in Nigeria. This finding also revealed that technical training had significant impact on solar renewable entrepreneurship, hydropower entrepreneurship and renewable energy consulting in Nigeria. The finding agrees recent studies conceptually, empirically that technical training had significant impact on solar renewable entrepreneurship, hydropower entrepreneurship and renewable energy consulting (Abd Majid, et al., 2024; Brown, & De Neve, 2024; Gong, et al., 2024; Daoudi, 2024; Amalu, et al., 2023).

The study revealed that research and development training had efffect on hydropower entrepreneurship in Nigeria. That is, the study showed that research and development training had significant impact on solar renewable entrepreneurship, hydropower entrepreneurship and renewable energy consulting in Nigeria. This finding was supported by recent studies conceptually that research and development had significant impact on solar renewable entrepreneurship, hydropower entrepreneurship and renewable energy consulting operations (Nguyen-Van, & Chang, 2024; Bilderback, 2024; Li, et al., 2023).

The study also showed from its analysis that policy and regulation training had effect on renewable energy consulting in Nigeria. That is, the study showed that policy and regulation training had effect on solar renewable entrepreneurship, hydropower entrepreneurship and renewable energy consulting in Nigeria. This finding was supported by recent studies conceptually that policy and regulation training had significant impact and effect on solar renewable entrepreneurship, hydropower entrepreneurship and renewable energy consulting operations (Hinterleitner, et al., 2024; Comunale, & Manera, 2024; Onuh, et al., 2024; Ekung, & Opoku, 2024).

CONCLUSION AND RECOMMENDATIONS

5.1 Conclusions

The study concluded based on the above findings that training had positive significant effect on renewable energy entrepreneurship in Nigeria. holistically from these findings, the study concluded that training is a strategic pillar that hold the effectiveness and sustainable operation of renewable energy entrepreneurship in terms of solar renewable entrepreneurship, hydropower entrepreneurship and renewable energy consulting in Nigeria. This conclusion had addressed the main objective of the study that examines the effect of training on renewable energy entrepreneurship in Nigeria. The study concluded that technical, research and development, and policy and regulation trainings had positive significant effect on renewable energy entrepreneurship in terms of solar renewable entrepreneurship, hydropower entrepreneurship and renewable energy consulting in Nigeria. These conclusions had addressed the objectives of the study.

In conclusion, the study on training and renewable energy in Nigeria highlights the critical need for continuous capacity building to drive sustainable energy development. Adequate training programs can equip professionals and local communities with the skills required to manage, operate, and maintain renewable energy systems effectively. Strengthening education, technical expertise, and policy support will enhance innovation, reduce dependency on fossil fuels, and promote green growth. Ultimately, investing in human capital is essential for achieving Nigeria's renewable energy goals and fostering long-term economic resilience.

5.2 Recommendations

Studying the effect of training on renewable energy entrepreneurship in Nigeria suggested recommendations to enhance effectiveness and outcomes:

Technical Training: Stakeholders in renewable energy entrepreneurship in Nigeria should design training programs that address the specific needs of the sector, with a focus on practical skills and local market realities. Entrepreneurs need hands-on training in areas like solar panel installation, maintenance, and energy storage to improve their technical competence.

Research and Development Training: Additionally, integrating entrepreneurship education into research and development (R&D) training is vital. This approach ensures that, alongside technical knowledge, entrepreneurs gain essential business, management, and marketing skills needed to build successful renewable energy enterprises.

Policy and Regulation Training: Moreover, training on policy and regulation should cover local and global renewable energy laws, helping entrepreneurs navigate compliance requirements. Collaboration between government agencies, industry players, and regulatory bodies will strengthen policy understanding and implementation in the sector.

5.3 Contributions to Knowledge

This study on training and renewable energy in Nigeria contributes significantly to existing knowledge by addressing critical gaps in human capacity development and sustainable energy adoption. It highlights the lack of structured training programs that integrate technical, managerial, and policy-oriented skills necessary for effective renewable energy deployment. By examining the relationship between workforce preparedness and the growth of the renewable energy sector, the study provides insights into how skill acquisition influences technology adoption and long-term sustainability. It also bridges the knowledge gap on institutional collaboration between educational bodies, industries, and government agencies, offering a practical framework for capacity building. Ultimately, the research deepens understanding of how targeted training initiatives can accelerate Nigeria's transition toward cleaner and more reliable energy systems.

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