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ANALYSING THE INDIRECT EMPLOYMENT AND BUSINESS OPPORTUNITIES FROM THE SHIFT TO RENEWABLE ENERGY-POWERED TRANSPORTATION IN ABUJA, NIGERIA

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Abstract

This research examines the indirect job and business opportunities that renewable energy-powered transportation creates in Abuja, Nigeria. Employing a mixed-methods framework, the study integrated survey results with stakeholder interviews. Descriptive statistics indicated strong potential for job creation in information and communication technology (ICT), technical maintenance, and logistics. Regression analysis demonstrated a significant positive correlation between the uptake of renewable energy in transportation and employment growth. Thematic analysis of the interviews uncovered four common themes: potential for job creation, involvement of youth and women, challenges and risks, and a perspective on sustainability. The combined findings suggest that renewable-powered transportation can spur inclusive green growth in Abuja, provided that issues related to financing, technical training, and regulatory uncertainty are addressed. The study concludes with suggestions for bolstering financial mechanisms, improving technical skills, encouraging inclusivity, and more broadly integrating urban sustainability frameworks.

Keywords: Renewable energy transportation, Job creation, Business opportunities, Empowerment of youth and women, Sustainable urban mobility and Green economy

1. Introduction

The worldwide shift toward renewable energy-powered transportation has gained considerable momentum recently, as countries seek sustainable means to combat climate change, reduce reliance on fossil fuels, and promote green economic development (Magaji et al., 2025). The transportation sector is responsible for nearly a quarter of global energy-related carbon dioxide (CO_2) emissions, making it a key area for decarbonization efforts (International Energy Agency [IEA], 2023). Renewable energy-based mobility—particularly through electric vehicles (EVs), hybrid systems, and renewable-powered public transport—not only provides environmental benefits but also yields extensive socioeconomic impacts. In addition to the direct jobs created by manufacturing, operations, and infrastructure development, these transitions foster a range of indirect jobs and business opportunities throughout supply chains, service industries, and local entrepreneurial environments (International Renewable Energy Agency [IRENA], 2022).

In Africa, discussions surrounding renewable transportation are frequently framed in terms of environmental or infrastructural concerns, with less focus on socioeconomic consequences. Nonetheless, forecasts indicate that the switch to renewable energy in Africa could create millions of jobs across value chains, both directly and indirectly

(United Nations Economic Commission for Africa [UNECA], 2022). Nigeria, being the largest economy and most populous country on the continent, confronts the dual challenge of high unemployment—especially among the youth—while fulfilling its obligations under global climate agreements. Therefore, the connection between renewable energy-powered transportation and indirect economic opportunities deserves greater examination, particularly in the Federal Capital Territory (FCT), Abuja.

Nigeria's reliance on oil revenues and fossil fuel consumption has historically impeded progress toward low-carbon energy systems. Nevertheless, the government has initiated various reforms aimed at incorporating renewable energy into the national energy portfolio. The Renewable Energy Master Plan (REMP) and the National Renewable Energy and Energy Efficiency Policy (NREEEP) outline ambitious goals for renewable energy contributions to national consumption by 2030 (Federal Government of Nigeria, 2016). Likewise, Nigeria's Energy Transition Plan, revealed in 2021, aims to decarbonise transport through the implementation of EVs, renewable-powered buses, and the expansion of charging infrastructure (Energy Commission of Nigeria, 2021).

In Abuja, trial initiatives—such as pilot programs for electric buses, solar-powered charging stations, and proposed policies for green public transportation—are already being evaluated (Obi & Madueke, 2023). Given Abuja's prominent status as the administrative capital and its relatively developed infrastructure, it serves as an ideal testing ground for renewable transport models. However, the socioeconomic consequences of these initiatives remain insufficiently explored in academic literature, particularly regarding indirect job creation and business growth.

The impacts of renewable energy on employment can be broadly categorised into direct, indirect, and induced effects. Direct employment refers to positions associated explicitly with renewable energy production or transportation services, such as assembling electric vehicles (EVs) or installing solar panels. Indirect employment encompasses jobs within supply chains and support services, including logistics, part distribution, and the maintenance of charging infrastructure. Induced employment is generated from the overall increase in consumer spending by those employed in both direct and indirect roles (Blyth et al., 2014).

In Abuja, the potential for indirect employment is notably high. The implementation of renewable energy transportation could spur growth in industries such as EV charging service operators, component suppliers, digital payment solutions, and other services located near transportation hubs. Opportunities in the informal sector may also arise as local business owners adjust to increased passenger traffic and energy demands by providing services such as roadside maintenance, battery recycling, or retail offerings close to charging stations. Research from other developing areas indicates that the adoption of renewable energy encourages a variety of small and medium-sized enterprises (SMEs), thereby enhancing local economic stability (Oluwafemi & Adeniran, 2021).

Additionally, renewable transportation has the potential to reshape urban environments by generating a demand for new technical skills and business models. There has been a growing establishment of training centres, technical colleges, and start-ups that focus on renewable energy services throughout Nigeria, illustrating the potential for skill-driven indirect employment (Okafor & Agwu, 2020). As a rapidly urbanising region with significant youth unemployment, Abuja presents a distinct opportunity to capitalise on these indirect economic benefits.

Despite the growing body of global literature on green jobs and transitions to renewable energy, empirical studies regarding Nigeria, specifically Abuja, remain limited. Much of the existing research focuses on the technical feasibility, energy efficiency, and climate benefits of renewable energy (Akinyele et al., 2020; Oyewo et al., 2021). There is considerably less information available on the economic ripple effects, particularly concerning the indirect employment and entrepreneurial ventures that result from renewable energy-driven transportation.

This knowledge gap is especially critical for policymakers and development planners, given Nigeria's ongoing challenges with unemployment and poverty. Reports from the National Bureau of Statistics (NBS, 2022) indicate that more than 40% of Nigerians live under the poverty threshold, while the rates of unemployment and underemployment are disproportionately elevated among the youth (Adekoya, Magaji, & Ismail, 2025). Therefore, it is crucial to understand how initiatives in renewable transportation can indirectly create jobs and encourage business development, thereby incorporating sustainable transport planning into Nigeria's more comprehensive economic development frameworks.

This study aims to analyse the indirect employment and business opportunities that arise from the transition to renewable energy-based transportation in Abuja.

2. Literature Review

2.1 Conceptual Definitions

Renewable Energy-Powered Transportation: Renewable energy-powered transportation refers to mobility systems that utilise energy sourced from naturally replenishing resources, such as solar, wind, biomass, and hydropower. This encompasses practical applications such as electric vehicles (EVs), hybrid systems, hydrogen fuel-cell vehicles, and public transport systems supported by renewable energy infrastructure (International Renewable Energy Agency [IRENA], 2022). In Abuja, the focus of renewable transport initiatives is mainly on electric vehicles, solar-powered charging stations, and pilot projects involving renewable-powered buses (Obi & Madueke, 2023). These systems not only promote environmental sustainability but also have considerable potential to reduce urban pollution and decrease Nigeria's dependence on imported fossil fuels, thereby enhancing national energy security (Akinwale, 2021).

Indirect Employment:Jobs created as a result of the transition to renewable energy can be categorised into three types: direct, indirect, and induced. While direct employment refers to positions involved in the design, production, and operation of renewable energy systems, indirect employment arises from activities within the supply chain or services that support the renewable sector, including logistics, parts manufacturing, the construction of charging stations, and the distribution of components (Blyth et al., 2014; United Nations Economic Commission for Africa [UNECA], 2022).In Nigeria, the creation of electric vehicle (EV) charging hubs not only provides jobs for technicians but also encourages the growth of small businesses along transport routes. In developing economies, the indirect effects of employment can often outweigh direct effects, particularly as renewable energy projects collaborate with local informal and small-scale businesses (Adegoke & Ayodele, 2023). In Abuja, the advancement of renewable transportation could foster clusters of job opportunities for artisans, mechanics who receive retraining for EV maintenance, and ICT professionals delivering digital solutions for energy management and mobility services.

Opportunities for business development in renewable-powered transportation are driven by the rise of new transport ecosystems, creating entrepreneurial avenues. These prospects encompass formal businesses like EV dealerships and battery leasing services, as well as informal enterprises such as retail shops, roadside mechanics pivoting to EV maintenance, and small and medium-sized enterprises (SMEs) offering digital payment solutions for transportation services (Okafor & Agwu, 2020). Government policies, consumer preferences, and financial factors influenced these business opportunities (Magaji, Musa, & Dogo, 2023), as well as the presence of renewable infrastructure (Oluwafemi & Adeniran, 2021). With urbanisation and the growing aspirations of the middle class driving transportation needs, the renewable transportation market in Abuja is becoming increasingly appealing to both domestic and international investors. Concurrently, small entrepreneurs in peri-urban areas stand to gain from related services, such as renewable-powered charging kiosks and solar-based mobility sharing programs.

Efforts aimed at reducing poverty are multifaceted, focusing on alleviating deprivation faced by individuals and households (Shaba et al., 2018). These efforts encompass aspects like income, education, healthcare, energy accessibility, and livelihood prospects (World Bank, 2022). The ultimate goal is to eradicate poverty (Magaji, 2007). The persistence of poverty can be attributed to its complex nature (Magaji et al., 2022). In the realm of renewable energy-driven transportation, poverty alleviation is linked to the indirect promotion of income generation and the narrowing of income disparities (Enaberue, Musa, & Magaji, 2024). Moreover, it reduces transportation expenses and enhances access to opportunities that rely on mobility, such as education, healthcare, and markets (Gabdo & Magaji, 2025). For example, affordable, renewable-powered public buses or shared EV systems can lessen the financial burden of transportation on low-income residents in Abuja, all while creating jobs throughout the renewable value chain (Eleri & Ugwu, 2022). Additionally, informal business prospects such as EV battery recycling, micro-mobility services (e-scooters, e-tricycles), and renewable logistics platforms can enable marginalised groups, particularly women and youth, to explore new economic opportunities (Muhammed, Magaji, & Ismail, 2025). By tackling unemployment and enhancing livelihood stability, the adoption of renewable transport directly contributes to Nigeria's Sustainable Development Goals (SDGs), particularly Goal 1 (No Poverty), Goal 7 (Affordable and Clean Energy), and Goal 8 (Decent Work and Economic Growth) (United Nations Development Programme [UNDP], 2021).

2.2 Theoretical Framework

The Green Jobs Theory asserts that environmental sustainability and job creation are interconnected rather than independent. According to the International Labour Organisation (ILO, 2019), green jobs encompass roles that contribute tothe preservation or restoration of the environment. These comprise both direct and indirect job opportunities arising from the adoption of renewable energy. In the context of Abuja, this theory indicates that renewable-powered transportation can lead to job growth in emerging sectors while revitalising existing industries.

The Keynesian Multiplier theory provides insight into how investments in renewable energy can yield broader economic impacts. Spending in a particular sector (for instance, renewable transport infrastructure) can spur

additional demand in related industries, resulting in indirect and induced job creation (Fankhauser et al., 2008). For example, investing in EV infrastructure in Abuja may increase demand for electricians, software developers, and SMEs that supply ancillary services.

Sustainable Development Theory: Sustainable development focuses on meeting current needs without compromising the needs of future generations (Brundtland Commission, 1987). In the realm of transportation, the implementation of renewable energy aligns with environmental, economic, and social sustainability. From this perspective, transitioning to renewable-powered transportation in Abuja not only reduces emissions but also meets socioeconomic demands, particularly in terms of job creation and business innovation (Akinyele et al., 2020).

Human Capital Theory: Human Capital Theory (Becker, 1993) emphasises the significance of skills and knowledge in shaping economic outcomes. The move towards renewable transportation necessitates the acquisition of new technical skills (for instance, EV maintenance, battery management, and renewable charging technologies). Therefore, investing in training and capacity-building in Abuja is vital for optimising the indirect employment and business prospects that arise from the energy transition.

2.3 Empirical Evidence

Worldwide, the shift to renewable energy-powered transportation is associated with significant indirect employment and entrepreneurial opportunities. The International Renewable Energy Agency (IRENA, 2022) reported that the renewable energy sector provided jobs for over 12.7 million individuals in 2021, with transportation-related initiatives—such as electric vehicles (EVs), biofuels, and charging infrastructure—contributing an increasing portion of indirect employment. These positions emerge not just from direct manufacturing but also from activities upstream and downstream, including logistics, supply chains, research, and after-sales services.

In China, which has the largest EV market globally, there has been considerable growth in indirect employment in battery recycling, software development for smart mobility, and the management of charging infrastructure (Zhang et al., 2020). Li and Liu (2021) noted that digital mobility platforms that support EVs, such as ride-hailing services, have created additional job opportunities based on services such as data analytics, fintech integration, and customer support. Likewise, in the European Union, projects based on renewable-powered transport have stimulated indirect jobs in small and medium-sized enterprises (SMEs), particularly within logistics, information technology, and component distribution (European Commission, 2021; European Investment Bank, 2022).

Evidence from Asia also supports the employment claim. In India, solar-powered rickshaw initiatives not only provided direct employment for drivers but also indirectly invigorated local economies through the development of battery repair shops, informal spare parts vendors, and maintenance businesses (Sarkar & Ghosh, 2019). Kumar and Singh (2022) reported that entrepreneurship at the community level thrived as SMEs emerged to service charging stations and manage fleets powered by renewable energy. In Latin America, Molina and Toledo (2021) found that renewable-powered transit routes benefited informal urban vendors, who gained from increased passenger activity, triggering a chain of economic improvements across small businesses, such as food stalls and service kiosks.

In Africa, renewable-powered transportation is increasingly viewed as a catalyst for indirect green employment. The United Nations Economic Commission for Africa (UNECA, 2022) estimated that the continent could create over 2 million green jobs annually by increasing investments in renewable energy, including those in sustainable transportation. A notable example is Kenya, where the growth of solar-powered motorbike taxis has not only created direct jobs for riders but also indirect positions in managing charging stations, repairing parts, and integrating mobile payments (Njoroge, 2021).

South Africa's transportation policies linked with renewable energy have also shown significant indirect effects. Baker (2020) documented that the adoption of EVs in Johannesburg led to job creation in component assembly, parts distribution, and community-based maintenance cooperatives. In Ethiopia, government-supported investments in solar mini-grids and electric bus pilots have led to the development of supportive services, including ICT-enabled fleet management and renewable-powered repair facilities (Gebreslassie, 2021). Furthermore, Ouedraogo et al. (2023) found that embracing renewable energy across West Africa enhanced the competitiveness of SMEs by reducing energy expenses, thereby indirectly facilitating new business opportunities in the service industry.

The African Development Bank (AfDB, 2021) noted that localised renewable transportation systems typically yield the most significant indirect employment benefits in areas with strong informal economies. For example, informal charging stations and repair centres in urban areas of Kenya and Uganda have evolved into micro-businesses that foster economic engagement at the community level. In Nigeria, although renewable transportation is still in its early stages of development, there is emerging evidence of substantial indirect employment and entrepreneurial opportunities. Akinyele et al. (2020) highlighted that renewable energy systems—exceptionallydecentralised solar initiatives—are poised to create numerous jobs in distribution, installation, and technical services. While the majority of current research emphasises energy access rather than transportation, their

findings are relevant, as renewable-powered transport necessitates similar infrastructures, such as solar mini-grids and ICT-enabled service platforms.

Okafor and Agwu (2020) explored the relationship between green jobs and youth employment, indicating that renewable energy could accommodate Nigeria's growing youth demographic if issues such as limited technical training, inadequate financing, and inconsistent policies are addressed. Obi and Madueke (2023) focused on electric vehicle adoption in Nigeria, noting the ancillary benefits for ICT-enabled services, fintech solutions for transport payments, and infrastructure development. Similarly, Adegboye and Oladipo (2022) demonstrated that the expansion of solar-powered businesses has already contributed to employment within informal distribution networks and after-sales service.

Oluwafemi and Adeniran (2021) provided empirical evidence that embracing renewable energy significantly enhanced the productivity of SMEs in sub-Saharan Africa by lowering electricity expenses and paving the way for new service markets. When applied to Abuja, this implies that renewable-powered transportation could also boost entrepreneurial activities in sectors like EV charging businesses, e-mobility logistics, and solar-powered fleet services.

In Abuja, in particular, small solar enterprises have created indirect employment opportunities in distribution, technical installation, and maintenance, as noted by Ibrahim & Usman (2022). If these principles are extended to renewable transport systems, they are likely to stimulate new value chains involving SMEs, ICT platforms, and informal service providers. Furthermore, Oyebanji and Adeoye (2024) argued that Nigeria's current subsidy reforms and renewable transition could bolster local entrepreneurship in the intersection of transport and energy, especially in cities like Abuja, where the demand for mobility solutions, both public and private, is rising rapidly.

Literature Gaps: Despite the increasing acknowledgement of the employment potential in renewable energy, several gaps remain:

i. Limited Localised Studies – Most research in Nigeria remains national or theoretical, with insufficient empirical studies focusing specifically on Abuja.

ii. Indirect vs. Direct Employment – The existing literature tends to emphasise direct job creation (such as EV assembly) while failing to consider indirect effects in supporting industries.

iii. Dynamics of the Informal Sector – Few studies investigate how renewable transport prompts informal businesses, notwithstanding Nigeria's predominantly informal economy.

iv. Linkages between Policy and Employment – There has been an insufficient connection made in research between Nigeria's renewable energy policies (REMP, NREEEP, Energy Transition Plan) and quantifiable employment results in the transport sector.

The literature reviewed suggests that transportation powered by renewable energy has significant potential to create indirect jobs and foster new business opportunities. Although global and regional evidence highlights these advantages, Nigeria, specifically Abuja, remains under-researched. By employing Green Jobs Theory, Spillover Effects, Sustainable Development, and Human Capital Theory, this study aims to provide a comprehensive analysis of the indirect economic impacts generated by renewable transport initiatives in Abuja.

3. Methodology

3.1 Research Design

This study employs a mixed-methods approach, combining both quantitative and qualitative methods. The justification for this approach stems from the multifaceted nature of indirect employment and the business opportunities that arise from renewable energy-powered transportation. Quantitative data is essential to quantify the extent of employment and business outcomes, while qualitative perspectives are vital for examining stakeholder views, entrepreneurial innovations, and contextual challenges. According to Creswell and Creswell (2018), mixed-methods research enhances validity by amalgamating numerical trends with contextual stories, which is particularly relevant for addressing both employment consequences and business interconnections in Abuja.

3.2 Study Area

The research took place in Abuja, the Federal Capital Territory (FCT) of Nigeria. Abuja serves as a pivotal site for examining transportation powered by renewable energy due to its rapidly growing population, crucial role in implementing national policies, and increasing interest in sustainable mobility. The city features numerous pilot initiatives focused on solar-powered transportation and the adoption of electric vehicles (EVs), as well as small and medium-sized enterprises (SMEs) involved in the distribution, maintenance, and logistics of renewable energy (Obi & Madueke, 2023).

3.3 Population and Sampling

The population for the study consisted of three primary groups:

i. Small and Medium Enterprises (SMEs) engaged in renewable energy or transportation services (such as charging stations, solar installations, battery recycling, and maintenance).

ii. Workers in the transportation sector, including drivers, technicians, and operators of charging stations.

iii. Stakeholders in policy and regulation from governmental bodies, including the Federal Ministry of Transport, the Nigerian Electricity Regulatory Commission (NERC), and the Energy Commission of Nigeria (ECN).

A multistage sampling approach was utilised. Initially, purposive sampling was used to identify key areas in Abuja where renewable energy or electric mobility activities were taking place, such as Garki, Wuse, Utako, and Nyanya. This was followed by stratified sampling to ensure varied representation across different SME categories and types of transport workers. Finally, simple random sampling was applied to select participants within each stratum. A total of 200 participants were aimed to be included: 120 SME operators, 60 transport workers, and 20 policymakers/experts.

3.4 Data Collection Methods

Data was gathered through both primary and secondary avenues:

i. Primary Data: Structured questionnaires were distributed to SME operators and transport workers to gather quantitative information on indirect employment, business prospects, and obstacles faced. Key Informant Interviews (KIIs) were conducted with policymakers and renewable energy specialists to gather their perspectives on facilitating policies, institutional frameworks, and perceived opportunities for renewable energy development. Focus Group Discussions (FGDs) were conducted with drivers and technicians to explore their experiences with renewable energy-powered transportation.

ii. Secondary Data: Relevant reports from the International Renewable Energy Agency (IRENA), the United Nations Economic Commission for Africa (UNECA), the Federal Ministry of Transport, and scholarly articles were analysed to provide context for the findings.

3.5 Data Analysis

The Analysis Utilised a Triangulation Method:

Quantitative Data Analysis: Responses from the questionnaires were coded and analysed with the Statistical Package for the Social Sciences (SPSS v.25). Descriptive statistics (such as frequencies, percentages, and means) were employed to summarise indicators related to employment and business. Inferential statistics, specifically chi-square tests and regression analysis, were employed to examine the relationships between the adoption of renewable transportation and employment outcomes.

Qualitative Data Analysis: KIIs and FGDs were transcribed and analysed thematically using NVivo software. Key themes, including entrepreneurial innovation, policy challenges, and growth trajectories for SMEs, were identified and compared with quantitative trends.

3.6 Validity and Reliability

To guarantee validity, the questionnaire underwent pre-testing with 20 respondents in Gwagwalada, Abuja, to clarify unclear questions. The content validity was strengthened by aligning survey items with previous research (Okafor & Agwu, 2020; Obi & Madueke, 2023). Reliability was assessed using Cronbach's alpha, setting an acceptable threshold of 0.70 for internal consistency (Nunnally & Bernstein, 1994).

3.7 Ethical Considerations

Ethical clearance was secured from the Research Ethics Committee at the University of Abuja. Informed consent was obtained from all participants, and their responses were anonymised to maintain confidentiality. Participants were informed of their right to withdraw from the study at any time.

4. Results

4.1 Data Presentation and Analysis

4.2 Socio-Demographic Characteristics of Respondents

table 1: socio-demographic profile of respondents (n = 200)

Variable	Category	Frequency	Percentage (%)
Gender	Male	138	69.0
	Female	62	31.0
Age	18–30 years	70	35.0
	31–45 years	90	45.0
	46 years and above	40	20.0
Education Level	Primary/Secondary	58	29.0
	Tertiary	142	71.0
Employment Status	Self-employed	116	58.0
	Wage employed	52	26.0
	Unemployed	32	16.0

Source: Field Survey (2025)

4.3 Employment Indicators

Respondents were asked about the employment creation potential of renewable transportation.

table 2: perceived employment opportunities in renewable transportation

Employment Indicator	Agree (%)	Neutral (%)	Disagree (%)	Mean	Std. Dev.
Creates new jobs in the charging infrastructure	71.0	15.5	13.5	3.65	0.92
Expands opportunities in battery repair/recycling	68.5	18.0	13.5	3.58	0.89
Provides indirect jobs in ICT-enabled services	61.0	21.5	17.5	3.45	0.95
Boosts transport-related SMEs (e.g., logistics)	74.5	12.5	13.0	3.72	0.86

Scale: 1 = Strongly Disagree, 5 = Strongly Agree. Source: Field Survey (2025)

The results show that over 70% of respondents agreed that renewable-powered transport generates jobs in charging infrastructure and SMEs, with mean values above 3.5, indicating strong agreement.

4.4 Business Development Indicators

table 3: business opportunities linked to renewable transportation

Business Indicator	Agree (%)	Neutral (%)	Disagree (%)	Mean	Std. Dev.
Reduces energy costs for SMEs	76.0	11.0	13.0	3.80	0.84
Encourages entrepreneurship in EV services	69.0	16.0	15.0	3.62	0.91
Attracts foreign and local investment	63.5	20.0	16.5	3.51	0.93
Expands informal sector opportunities	58.0	23.0	19.0	3.38	0.96

Source: Field Survey (2025)

The findings indicate that renewable-powered transport is perceived as a significant enabler for SMEs, as it lowers energy costs and opens up entrepreneurship opportunities.

4.5 Inferential Statistics

4.5.1 Chi-Square Tests of Association

Chi-square analysis was conducted to test the relationship between socio-demographic variables and perceptions of employment opportunities.

table 4: chi-square test results

Variable	χ^2 Value	df	p-value
Gender × Employment opportunities	4.82	2	0.089
Age × Employment opportunities	10.46	4	0.034*
Education × Business opportunities	12.31	2	0.002*

Significant at $p < 0.05$. Source: Field Survey (2025)

The results indicate that age has a significant influence on perceptions of employment opportunities ($p = 0.034$), while education has a significant effect on perceptions of business opportunities ($p = 0.002$).

4.5.2 Logistic Regression Analysis

To further assess the predictive influence of renewable-powered transportation on indirect employment and business opportunities, a binary logistic regression model was estimated. The respondents' Employment and Business Outcome Index (composite scale) was dichotomised into High (1) and Low (0) outcomes based on the median split. Independent variables included Renewable Infrastructure (X_1), SME Opportunities (X_2), ICT-enabled Services (X_3), and Policy Support (X_4).

Model Fit Statistics

The logistic regression model demonstrated a good fit to the data, as indicated by a statistically significant likelihood ratio chi-square test, $\chi^2(4, N = 200) = 47.32$, $p < 0.001$, which suggests that the predictors collectively contributed to the model's predictive accuracy. The Nagelkerke R^2 value is 0.39, suggesting that approximately 39% of the variance in employment and business outcomes is explained by the predictors. The model correctly classified 77.5% of cases.

table 5: logistic regression results

Predictor Variable	β Coefficient	Wald χ^2	p-value	Odds Ratio (Exp(β))	95% CI for Exp(β)
Renewable Infrastructure	1.212	16.84	0.000*	3.36	1.91 – 5.92
SME Opportunities	0.874	10.95	0.001*	2.40	1.41 – 4.08
ICT-enabled Services	0.529	4.31	0.038*	1.70	1.03 – 2.83
Policy Support	0.214	1.02	0.312	1.24	0.81 – 1.90
Constant	-1.157	8.27	0.004*	0.31	–

Source: Field Survey (2025)

Interpretation of Findings

The logistic regression model indicates that three predictors were statistically significant:

Renewable Infrastructure had the most decisive influence ($\beta = 1.212$, $p < 0.001$), with respondents exposed to improved renewable infrastructure being 3.36 times more likely to report high employment and business outcomes compared to those with lower exposure.

SME Opportunities ($\beta = 0.874$, $p = 0.001$) also exerted a significant effect, with individuals perceiving greater SME opportunities being 2.40 times more likely to benefit from renewable transportation-driven employment/business prospects.

ICT-enabled Services ($\beta = 0.529$, $p = 0.038$) showed a modest but significant effect, suggesting that digital innovations linked to renewable mobility increase the odds of improved indirect economic outcomes by 70%.

Policy Support ($\beta = 0.214$, $p = 0.312$) was not statistically significant, indicating that respondents' perceptions of policy frameworks did not significantly predict employment and business opportunities.

Overall, the model suggests that the expansion of infrastructure, development of small and medium-sized enterprises (SMEs), and services driven by information and communication technology (ICT) are key factors influencing the indirect economic effects of transportation powered by renewable energy in Abuja, Nigeria.

4.5 Results from Thematic Analysis of Interviews

The qualitative data collected from key informant interviews provided detailed insights that enriched the quantitative findings. Thematic coding of the responses unveiled four main themes that influenced stakeholder perceptions regarding the indirect employment and business opportunities stemming from the transition to transportation powered by renewable energy in Abuja. The following themes are outlined below, accompanied by illustrative examples.

4.5.1 Job Creation Potential

A prevalent theme identified in the interviews was the view of renewable-powered transportation as a significant driver of job creation. Respondents highlighted indirect employment opportunities in sectors such as ICT-enabled ride-hailing applications, the maintenance and technical servicing of renewable-powered vehicles, and logistics operations that support transportation networks. Several participants noted that the development of charging stations, battery recycling centres, and solar-powered mini-grids for transportation infrastructure would generate micro-enterprises and create secondary job opportunities across Abuja's informal sector. This observation aligns with previous studies that highlight the employment multiplier effect of green transitions in emerging economies (International Renewable Energy Agency [IRENA], 2022; Magaji & Temitope, 2022).

4.5.2 Youth and Women Engagement

Another recurring theme was the acknowledgement of renewable transportation as an inclusive opportunity for economic empowerment, particularly for young people and women. Respondents consistently expressed the view that the reduced operational expenses of renewable-powered vehicles could decrease barriers to entry for small-scale entrepreneurs, including businesses led by women. Female participants emphasised opportunities in areas such as mobile charging services, ICT-based dispatch systems, and the retailing of solar components. This aligns with the findings of Olanrewaju et al. (2023), which state that the adoption of renewable energy in urban Africa often enhances inclusivity by providing affordable entry points for new business ventures. Furthermore, the technology-driven aspect of renewable transportation was perceived as particularly attractive to younger individuals, who are typically more adaptable to business models based on ICT.

4.5.3 Barriers and Risks

Despite the positive outlook, interviewees expressed concerns about various barriers that could hinder the realisation of indirect employment benefits. One frequently mentioned issue was financing gaps, with respondents noting that small businesses and startups often lack access to affordable credit necessary for investment in renewable transport-related ventures. Additionally, the inadequacy of technical training and the shortage of a skilled workforce in renewable energy systems were recognised as considerable risks. Respondents emphasised that without sufficient training programs, numerous potential jobs in renewable energy, such as servicing, diagnostics, and component manufacturing, may be outsourced rather than localised. Regulatory uncertainty was also pointed out as a limitation, with stakeholders highlighting the absence of comprehensive policy frameworks to support renewable transport enterprises. This aligns with existing literature on the institutional and financial barriers to transitioning to green transport systems in Sub-Saharan Africa (Egbue & Long, 2021; Okafor, 2024).

4.5.4 Sustainability Outlook

The concluding theme that emerged from the interviews was the sustainability perspective of renewable-powered transportation in Abuja. Stakeholders emphasised that the long-term success of this transition hinges on integrating renewable transport initiatives into broader green policies encompassing urban development, waste management, and environmental protection. Respondents argued that coordinated government support—from tax incentives for renewable enterprises to investment in intelligent mobility infrastructure—could establish Abuja as a benchmark city for sustainable transportation within Nigeria and the broader West African subregion. Notably, several participants pointed out that sustainability should encompass not only environmental considerations but also the socio-economic inclusivity of green transitions. This viewpoint aligns with the broader dialogue surrounding the Sustainable Development Goals (SDGs), particularly SDG 8 (Decent Work and Economic Growth) and SDG 11 (Sustainable Cities and Communities).

table 7: thematic analysis of interviews on indirect employment and business opportunities from renewable-powered transportation in abuja

Theme	Representative Quotes	Frequency of Mentions (n=25)	Implications
Job Creation Potential	"The introduction of electric buses will create more opportunities for technicians, software developers, and logistics managers."	21 (84%)	Renewable-powered transport is expected to stimulate indirect employment in ICT, technical servicing, and logistics, thereby diversifying Abuja's labour market.
Youth and Women Engagement	"Women can run small solar-charging kiosks or battery swap stations, while young people can innovate in mobility apps."	18 (72%)	Renewable transport could strengthen inclusive growth by engaging youth and women in entrepreneurship and service provision.
Barriers and Risks	"Without affordable financing and strong training programs, the benefits may remain concentrated among a few elite actors."	16 (64%)	Financial gaps, technical skill shortages, and weak regulatory frameworks may hinder the equitable distribution of employment and business opportunities.
Sustainability Outlook	"If Abuja aligns renewable transport with broader green city policies, it could be a model for the rest of Nigeria."	20 (80%)	Integrating renewable-powered transport with sustainability initiatives could enhance Abuja's global image and long-term green development trajectory.

Source: Field Interviews (2025)

4. 5 Triangulation

The research employed a methodological triangulation approach, integrating quantitative survey data with qualitative interviews to gain a comprehensive understanding of the indirect employment and business prospects associated with renewable-powered transportation in Abuja. The quantitative findings revealed significant correlations between the adoption of renewable transport and employment metrics, particularly within ICT services, technical maintenance, and logistics, as supported by chi-square and regression analyses. These results were further corroborated by thematic analysis of the interviews, which underscored common themes regarding the potential for job creation, involvement of youth and women, challenges posed by insufficient financing and training, and the sustainability outlook. This alignment of findings strengthens the credibility of the research, demonstrating that both statistical and experiential evidence support renewable-powered transportation as a feasible approach to promoting inclusive and sustainable employment in the Federal Capital Territory.

5. Conclusion

This research examined the indirect employment and business opportunities generated by renewable-powered transportation in Abuja. The findings suggest that in addition to decreasing carbon emissions, renewable-powered transport holds significant promise for job creation in ICT, logistics, and technical services, while also encouraging entrepreneurial ventures for youth and women. However, to fully realise these advantages, it is crucial to address fundamental challenges such as funding shortfalls, a lack of technical training, and uncertainties in regulations. Integrating renewable-powered transport into Abuja's wider sustainability policies is essential for ensuring its long-term success and positioning the city as a benchmark for green mobility in Nigeria.

6. Recommendations

1. Enhance Financing Options: The government should create investment funds for renewable transport and foster public-private partnerships to bridge funding gaps and facilitate broad adoption.
2. Broaden Technical Training: Vocational and higher education institutions need to integrate renewable-powered transport topics into their curricula to cultivate a skilled workforce.
3. Establish Regulatory Guidelines: Development of clear policies and standards is necessary to govern battery charging, grid integration, and private sector involvement.
4. Foster Inclusiveness: Empowerment programs specifically aimed at women and youth entrepreneurs should be incorporated into renewable mobility initiatives.
5. Integrate Policies: Abuja's urban planning must align renewable-powered transport with broader green projects such as waste-to-energy initiatives, innovative city development plans, and sustainable housing strategies.

7. Contribution to Knowledge

This research adds to the existing body of knowledge in several ways:

1. It offers empirical data from Nigeria regarding the indirect employment potential of renewable-powered transport, an area that has seen limited previous study.
2. It employs a mixed-methods approach, triangulating quantitative data with qualitative insights from stakeholders, thus providing a comprehensive picture of the socio-economic effects of renewable transport.
3. It emphasises pathways for inclusive development, with a specific focus on youth and women, illustrating how renewable transport can be utilised for equitable growth.
4. It presents policy-relevant insights, highlighting the importance of incorporating renewable-powered transport into broader urban sustainability strategies within African cities.

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