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Assessment of Community Acceptance of Hydrogen and Alternative Liquid Fuels (H2&ALF) in Nigeria: Bridging Environmental Goals and Public Perception

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ABSTRACT

The growing need for environmentally sustainable energy across the globe has raised the level of interest for Hydrogen and Alternative Liquid Fuels (H2&ALF) as feasible sources of energy apart from the traditional fossil fuels. Although the use of such energy sources is economically and environmentally viable, the successful implementation of the process hinges on the level of acceptance and perception of the public. The empirical evidence on the same is still scanty especially in developing countries like Nigeria. This study evaluated the community acceptance of Hydrogen and Alternative Liquid Fuels (H2&ALF) in Nigeria with particular focus on the linkage between environment and public perception. Descriptive survey research design was used. Data was obtained through the use of a self-structured questionnaire which was distributed to respondents using the Taro Yamane sampling method. Descriptive analysis using frequency, percentage, mean and standard deviation were applied in analyzing the data. The results indicated that the respondents have shown good perception of hydrogen fuel and alternative liquid fuels because of the environmental benefits associated with them and their potentials in promoting sustainable energy development. Some challenges that can impact the process include public awareness, safety, policy implementation and infrastructure preparedness. It is concluded that environmental education, stakeholder involvement, transparent government policy formulation and community participation can greatly influence public acceptance of hydrogen technology.

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1.0 INTRODUCTION

The world's move to sustainable energy has made scientists explore new and eco-friendly sources of energy as alternatives to the existing fossil fuel sources. Hydrogen fuel and alternative liquid fuels (H2&ALF) are some of the technologies that have been considered in this regard owing to their contribution to lower carbon footprints, energy security and facilitating net-zero carbon emissions. Green hydrogen, which is generated from energy obtained through electrolysis, is especially recognized as a clean energy carrier that facilitates decarbonization of transport, manufacturing, power generation and production in industry (Obanor et al., 2024; Ikeuba et al., 2024). Alternative liquid fuels that include biofuel, renewable methanol, and synthetic fuels among others, also provide a means of decreasing dependency on petroleum sources of energy in addition to being environmentally friendly and contributing to economic growth (Obanor et al., 2024; Ikeuba et al., 2024).

Environmental sustainability involves the use of the available natural resources in such a way that current energy needs are met without depriving future generations of the capacity to meet their needs. Environmental sustainability can be directly achieved through the use of hydrogen fuel and alternative liquid fuels as these forms of energy help reduce carbon emissions, promote cleaner production processes, and improve air quality. However, the implementation of these energy sources requires both technological advancements and the willingness of communities to embrace the technology in order for the process to succeed. This shows that the community acceptance is very important in energy transition projects because of its role in decision-making, policy implementation and sustainability (Steller et al., 2024; Gordon et al., 2024).

Community acceptance can be defined as the degree to which people and communities are ready to facilitate the adoption of new technology in their respective environments. As such, the concept of acceptance when used in reference to hydrogen fuel and alternative liquid fuels is a function of public perception, environmental awareness, institutional trust, risk assessment, and economic benefits among others. Public perception includes the attitude, views, beliefs, opinion and knowledge that people have towards new technology and its impacts. Positive public perception increases acceptance and improves behavior towards clean energy technologies while misperception on issues of safety, cost, complexity and environmental impact among others could limit acceptance and adoption of new technology. For this reason, understanding community attitudes has become critical in sustainable energy planning and environment policymaking (Steller et al., 2024; Gordon et al., 2024).

The link between hydrogen fuel, alternative liquid fuels, community acceptance, environmental sustainability and public perception is hence dynamic and mutual. Sustainability of environmental processes depends not only on innovative technology but also on willingness of the public to adopt cleaner sources of energy. Communities that view hydrogen technology and alternative fuels as environmentally friendly and viable will thus be supportive of government efforts at fostering energy transition. Lack of awareness and misperceptions can, however, derail investments, limit infrastructure development and compromise environmental campaigns. Despite the existence of research on hydrogen technology acceptance in developed nations, literature on developing nations, especially Nigeria, which has low levels of awareness and policy preparedness, is limited (Obanor et al., 2024; Omejeh et al., 2026). As aforementioned, Nigeria has sufficient renewable energy resources that can be utilized in hydrogen production and alternative fuel development. Nevertheless, little is known about community perception of the technology and whether or not the environmental objectives are consistent with public perception. Filling the information gap is important because a successful energy transition requires both technological innovation and societal acceptance. It is in recognition of this fact that this paper assesses community acceptance of Hydrogen and Alternative Liquid Fuels (H2&ALF) in Nigeria by examining the link between environmental goals and public perception.

1.1 Statement of Problem

With the growing threats of global warming and pollution, the shift away from fossil fuel-based energy toward greener options has become an international priority. Hydrogen and Alternative Liquid Fuels (H2&ALF) have been noted as prospective low-carbon energy technologies that not only reduce greenhouse gas emissions but contribute to the sustainable development of the economy as well. However, the successful introduction of any innovation into society requires community support and a positive attitude, which, in turn, can be influenced by various environmental and social factors. In this way, the absence of public acceptance and lack of community involvement can hamper energy transitions because innovations in this field are unable to succeed where the communities believe new energy sources to be risky, expensive, or unsuitable (Obanor et al., 2024; Gordon et al., 2024).

Despite the ongoing promotion of hydrogen as an important aspect of future energy systems by the government and international organizations, its public awareness and acceptance varies greatly among different societies. Recent research shows that such factors as risks associated with innovations, limited knowledge about the technologies in question, low level of trust in public institutions, worries about safety and affordability of energy, as well as poor stakeholder engagement negatively affect community attitudes towards innovations and, therefore, slow down the process of infrastructure construction, policymaking, and investment into the sphere (Steller et al., 2024; Gordon et al., 2024). Understanding the perspective of the communities with respect to hydrogen and alternative liquid fuels has become critical for the development of an environmental communication strategy.

In Nigeria, the problem is much more challenging since the energy sector of the country keeps relying on fossil fuels, although the renewable energy potential of the country is rather high. Despite the fact that the recent studies revealed the possibilities of green hydrogen production in Africa, no empirical evidence concerning acceptance of innovations, community awareness, and public perception is available in regard to Nigeria. The existing Nigerian research was focused on the technological and economic aspects of introducing hydrogen in the national economy, including technological feasibility, potential of renewable energy generation, policy framework, and investment perspectives (Obanor et al., 2024).

Empirically, the majority of studies on acceptance of hydrogen were conducted in Europe and other developed countries with quite different policy environment, technological preparedness, public awareness, and energy infrastructure compared to Nigeria. Additionally, systematic reviews of hydrogen acceptance research show significant geographical gaps in the area in the form of insufficient number of studies conducted in Africa, while there is increasing interest in green hydrogen production in the region. Therefore, the results obtained in the developed countries cannot be generalized easily to the Nigerian case since differences in socio-economic environment, environmental concerns, institutional trust, and public awareness can influence acceptance differently. In order to fill the gap, the present study will examine community acceptance of Hydrogen and Alternative Liquid Fuels (H2&ALF) in Nigeria.

1.2 Objective of study

1. To measure the extent of community acceptance of Hydrogen and Alternative Liquid Fuels (H2&ALF) in Nigeria.

2. To investigate the role of public perception in the acceptance of Hydrogen and Alternative Liquid Fuels (H2&ALF) in Nigeria.
3. To identify the correlation between environmental sustainability objectives and community acceptance of Hydrogen and Alternative Liquid Fuels (H2&ALF) in Nigeria.

1.3 Research Question

1. To measure the extent of community acceptance of Hydrogen and Alternative Liquid Fuels (H2&ALF) in Nigeria.
2. To investigate the role of public perception in the acceptance of Hydrogen and Alternative Liquid Fuels (H2&ALF) in Nigeria.
3. To identify the correlation between environmental sustainability objectives and community acceptance of Hydrogen and Alternative Liquid Fuels (H2&ALF) in Nigeria.

1.4 Significance of the Study

The importance of this study lies in its provision of empirical evidence concerning community acceptance of H2&ALF in Nigeria. This, therefore, would help policymakers to make decisions based on evidence that encourage participation of people, awareness programs, and good regulations that support the use of hydrogen and alternative fuel. Government ministries and environmental protection agencies will equally benefit as they will receive information that can help them to plan their environmental education and climate change strategies as well as clean energy initiatives in line with international and national sustainability plans (Obanor et al., 2024; IEA, 2024).

Also, energy stakeholders such as investors, energy firms, renewable energy companies, and non-governmental organizations will gain knowledge about the factors that influence community acceptance and public opinion about new energy technologies. Psychologists will equally gain from this study in that they will learn the psychological processes involved in environmental attitude, risk perception, and intention to adopt new energies. Again, this research will contribute positively to the existing literature and become an excellent source of information for any researcher and scholar studying environmental psychology, renewable energy, and sustainable development. Finally, the general population will greatly benefit through being made aware of the benefits of using hydrogen and alternative liquid fuels both environmentally and economically.

2.0 LITERATURE REVIEW

2.1 Conceptual Review

Hydrogen fuel and alternative liquid fuels (H2&ALF) have emerged as sustainable energy sources that can help ensure global decarbonization and reduction of the dependency on traditional fossil fuels. Hydrogen fuel, especially the green one produced using renewable energy in electrolysis, is known to produce minimal amounts of greenhouse gases, while alternative liquid fuels, including biofuels, renewable methanol, synthetic fuels, and sustainable aviation fuels, play an important role in ensuring clean transportation and energy supply. Such technological solutions are regarded as the key to energy security, climate change mitigation, and sustainable development of countries that implement the low-carbon economy (Obanor et al., 2024; International Energy Agency [IEA], 2024).

Community acceptance is defined as the degree to which individuals and communities are ready to support the process of implementation of emerging technologies in their social environment, which is based on trust, perceived benefits, risks, awareness, and confidence in government policies. Public perception is connected with community acceptance as it reflects beliefs, attitudes, knowledge, and assessments of people concerning the emerging hydrogen technologies and their impacts on the environment, economy, and society. Good public perception leads to the behavioral support and acceptance of the technology and its regulations, while bad public perception can lead to delays in implementation (Steller et al., 2024; Gordon et al., 2024).

The environmental goals are the set of national and international goals that aim to reduce greenhouse gas emissions, improve environmental performance, increase energy efficiency, and promote sustainable development. The interaction between H2&ALF, community acceptance, environmental goals, and public perception is bidirectional, as public confidence increases acceptance, acceptance promotes implementation, while implementation results in environmental sustainability. Therefore, all these concepts are highly interconnected (IEA, 2024; Obanor et al., 2024).

2.2 Empirical Literature Review

Community acceptance of hydrogen energy in the United Kingdom has been the topic of Gordon et al. (2024). This research was carried out to determine the effects of environmental benefits, public trust, and socio-economic expectations on hydrogen energy acceptance. This study used a quantitative design and applied Partial Least Squares Structural Equation Modeling (PLS-SEM) to gather data from households. Results indicated that perception of environmental benefits and community trust positively influenced public acceptance, while low institutional trust had negative influence. The researchers concluded that there is need for effective

public participation and clear communication strategy. Nonetheless, the study only considered the United Kingdom with scanty information concerning the acceptance of hydrogen energy in Nigeria. (Gordon et al., 2024).

2.3 Theoretical Review

The theory of choice of this study is the Theory of Planned Behavior (TPB) that was formulated by Icek Ajzen in 1985. The theory was intended to clarify how attitudes, subjective norms, and perceived behavior control affect intentions and behaviors of people. It was well-accepted after numerous empirical validations in environmental psychology, renewable energy uptake, and sustainable consumption. Many researchers have shown its applicability in predicting the acceptance of new environmental technologies and pro-environmental behavior (Ajzen, 2020; Wang et al., 2023). Nevertheless, it has been criticized by Sniehotta et al. (2014), who argue that the theory does not give enough consideration to the role of habitual behavior, emotions, and context in the decision-making process. In spite of such criticism, the theory remains highly relevant to the issue under discussion because the acceptance of Hydrogen and Alternative Liquid Fuels in the community will be conditioned by attitudes, subjective norms, and behavioral control related to the clean energy projects. Thus, the Theory of Planned Behavior is the right theory to analyze public perceptions and acceptance of H2&ALF technologies.

2.3.1 Relevance of the Theory to the Study

The Theory of Planned Behavior is a good theoretical basis for this study because it shows how positive attitudes, social influence, and perceived behavioral control can affect the acceptance of Hydrogen and Alternative Liquid Fuels for environment sustainability.

2.4 Gaps in Literature

Most of the existing literature is focused on the technical feasibility of hydrogen fuel and alternative liquid fuels and their environmental benefits, policy approaches, and economics, while empirical evidence regarding community acceptance and public perceptions is lacking, especially in Nigeria (Obanor et al., 2024). Likewise, existing research in Europe and developed nations highlights the behavioral determinants of hydrogen fuel acceptance but does not account for the peculiar social-cultural, institutional, and environmental factors prevailing in developing nations (Gordon et al., 2024; Steller et al., 2024). This research will address this empirical and contextual gap by studying the community acceptance of H2&ALF in Nigeria.

3.0 METHODOLOGY

3.1 Research design

The descriptive survey research design was employed in this study to determine community acceptance of Hydrogen and Alternative Liquid Fuels (H2&ALF) in Nigeria. This design was deemed suitable for use because it allows the researcher to gather primary data from respondents on the opinion, perception, attitudes and acceptance level of new green energy sources without manipulation of the research variables. Descriptive surveys have found common application in behavioral and environmental psychology because of their ability to give an accurate description of an existing phenomenon and analyze variables in relation to each other in a natural environment. Additionally, this research design allows the gathering of information from a large number of people, thus increasing the validity and reliability of the research results (Creswell & Creswell, 2023).

3.2 Population of the Study

The study population in this research was composed of 12,500 adult inhabitants selected from purposively sampled urban and semi-urban communities in some states in Nigeria, they are: Kano, Abuja, Ebonyi, Nasarawa, Rivers and Ondo states. The selected locations were chosen for their socio-economic status, education level, and awareness of environmental sustainability and evolving alternative energy sources. The study population included adult inhabitants who were at least 18 years older and able to express well-informed views concerning H2&ALF, environmental sustainability, and government energy policy issues. The population was considered appropriate due to being behavioral constructs which can be effectively examined in adults, who will be the potential beneficiaries and stakeholders in energy transition in Nigeria (Creswell & Creswell, 2023).

3.3 Sample size

In this research, the sample size used was calculated through the Taro Yamane formula in 1967 that gives a simpler approach to sampling from a finite population. It is written as:

$$n = \frac{N}{1 + N(e)^2}$$

Where:
n = Sample size
N = Population (12,500)
e = Margin of error (0.05)

$$n = \frac{12{,}500}{1 + 12{,}500\ (0{,}05)^2}$$

$$n = \frac{12500}{1 + 12500(0{,}0025)}$$

$$n = \frac{12500}{32.25}$$

n = 387.60

The calculated sample size was approximately **388** respondents.

3.4 Method of Data Collection

The data needed for the research was obtained using a self-structured questionnaire which was prepared by the researcher with reference to the objectives of the research as well as literature on Hydrogen and Alternative Liquid Fuels (H2&ALF), community acceptance, environmental sustainability, and public perception. The questionnaire consisted of two parts. In the first part was the demographic details of the respondents, while in the second part, was six structured questions for each of the three research objectives of the research. The responses were measured using a Likert Scale of 1 to 5 points where 5 points indicate Strongly Agree, 4 points indicate Agree, 3 points indicate Undecided, 2 points indicate Disagree, and 1 point indicates Strongly Disagree. The copies of the questionnaire was distributed to respondents both personally as well as through electronic means. The respondents were informed about the purpose of the research and assured of confidentiality and anonymity.

3.5 Method of Data Analysis

Analysis of data from the study involved descriptive statistics using the SPSS software version 29. The analysis employed frequency counts and percentages to analyze the demographic details of the respondents, while the use of mean and standard deviation helped answer the research questions and measure the extent of agreement by the respondents on the questionnaire items. The benchmark for the decision was the mean, with 3.00 as the cut-off mark, where a mean score of 3.00 and above meant acceptance, while below 3.00 was rejection.

4.0 RESULT AND DISCUSSION

The findings of objective one is consistent with those reported by Gordon et al. (2024) and Steller et al. (2024), who found that positive attitudes and trust in the community greatly increase acceptance of hydrogen technologies. The citizens show high levels of readiness to embrace hydrogen technology, indicating favorable conditions for its future implementation in Nigeria.

The result of objective two is consistent with Steller et al. (2024) as they have reported that positive public perception, trust, and safety affect the acceptance of hydrogen technology positively. It seems that positive public perception is very necessary to improve the acceptance of hydrogen energy technologies.

Furthermore, in the study, objective three is consistent with the findings by Obanor et al. (2024), which stated that environmental sustainability still drives acceptance of hydrogen energy in African societies. Environmental conservation is a strong motivator for acceptance and thus hydrogen energy technologies are valid alternatives for sustainable energy development.

4.1 Results of Analysis

Objective One: To measure the extent of community acceptance of Hydrogen and alternative Liquid Fuels (H2&ALF)

Options: 5-Strongly Agree, 4-Agree, 3- Disagree, 2- Strongly Disagree, 1-Undecided.

Table 4.1.1: Reponses in Relation to Community Acceptance of Hydrogen and Alternative Liquid Fuels

s/n	Statement	SA	A	U	D	SD	Mean	Decision
1	I will be able to advocate for the use of Hydrogen and Alternative Liquid Fuels (H2&ALF) in Nigeria.	176	118	28	18	9	4.25	Accepted
2	I feel that my community will em brace Hydrogen and Alternative Liquid Fuels (H2&ALF) as another form of energy source.s	169	122	31	17	10	4.21	Accepted
	Grand mean						4.23	Accepted

Source: Field Survey, (2026)

Interpretation

According to Table 4.1.1, the number of people who chose Strongly Agree and Agree is high, with an overwhelming majority of 83% from the total population. The grand mean of 4.23 is above the acceptable range of 3.00. This is proof of the fact that the community strongly accepts Hydrogen and Alternative Liquid Fuels.

Objective Two: To investigate the role of public perception in the acceptance of hydrogen and Alternative Liquid Fuels (H2&ALF) in Nigeria's performance

Table 4.1.2: Survey Results Relating to Public Perception of Hydrogen and Other Liquids

s/n	Statement	SA	A	U	D	SD	Mean	Decision
1	In my view, Hydrogen and Alternative Liquid Fuels (H2&ALF) can be used by the general public safely.	171	120	26	21	11	4.20	Accepted
2	My opinion on Hydrogen and Alternative Liquid Fuels (H2&ALF) impacts my readiness to support their use in N	180	116	24	18	11	4.25	Accepted
	Grand Mean						4.23	Accepted

Source: Field Survey, (2026)

Interpretation

The findings indicate that the majority of the respondents picked the options of Strongly Agree and Agree, making up 85% of the answers. This is because the overall mean of 4.23 implies that the public perception significantly impacts the likelihood of respondents being willing to support Hydrogen and Alternative Liquid Fuels**.**

Objective Three: To identify the correlation between environmental sustainability objectives and community acceptance of hydrogen and alternative Liquid fuels (H2&ALF)

Table 4.1.3: Answers to Environmentally Sustainable Development and Support for H2&ALF

s/n	Statement	SA	A	U	D	SD	Mean	Decision
1	I think that Hydrogen and Alternative Liquid Fuels (H2&ALF) will go a long way in protecting our environment from pollution.	184	114	24	18	9	4.28	Accepted
2	Environmental sustainability will be an important motivation for me to support H2&ALF in Nigeria.	189	111	22	17	10	4.30	Accepted
	Grand Mean						4.29	Accepted

Source: Field Survey (2026)

Interpretation

Table 4.1.3 demonstrates that most of the survey subjects have chosen Strongly Agree and Agree choices, which account for about 86% of all answers. With the grand mean of 4.29, it is safe to say that environmental sustainability is a powerful driver for people to embrace Hydrogen and Alternative Liquid Fuels.

4.2 Discussion of Findings

From the results, it is clear that there was a very high degree of acceptance of H2&ALF by the communities under investigation, with public attitude and environmental sustainability playing a very significant role in the acceptance of clean energy technologies by the participants. This is in line with the findings of the empirical literature by Gordon et al. (2024), Obanor et al. (2024), and Steller et al. (2024), where it has been shown that good public attitude and environmental awareness increase the acceptance of hydrogen technologies. The findings have validated the Theory of Planned Behavior, which states that attitudes play a crucial role in behavior towards innovations (Ajzen, 2022).

5.0 CONCLUSION, SUMMARY AND RECOMMENDATION

5.1 Conclusion

It is concluded from this study that community acceptance of H2&ALF in Nigeria will be positively affected by a favorable perception of the general public and considerations of environmental sustainability. Awareness and policy measures will help in achieving community acceptance and moving towards an environmentally sustainable energy system.

5.2 Summary

This study examined the level of acceptance of H2&ALF within the community in Nigeria through the analysis of public perception and environmental sustainability. The results showed that there is a high level of acceptance by the respondents, and the study found

that positive public perception and the environment play a major role in fostering acceptance of hydrogen and alternative liquid fuels.

5.3 Recommendations

According to the results, the study made the following recommendations:

1. The Federal Government should come up with policies that would help to promote the use of Hydrogen and Alternative Liquid Fuels (H2&ALF).
2. The environmental agencies should step up their nationwide campaigns in educating the people about the environment and economic benefits of hydrogen.
3. Energy stakeholders need to educate the communities and consult with them as well as demonstrate their benefits to foster public confidence and acceptance of hydrogen technology.
4. More studies need to be conducted by educational and research institutions on the behavior of people regarding the acceptance of clean energy in Nigeria.

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