

Challenges And Opportunities of the Implementation of NetZero Strategy: Analysis of Key Issues that Affect the Adoption of Domestic Renewable Energy in the UK from Consumers' Perspective

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ABSTRACT

Energy consumption is a recognised global issue, and with the increasing population, there has been a rapid increase in the production of energy to meet the ever-growing demand. However, there is an over-reliance on fossil fuels, which are depletable and cause carbon emission. However, considering the recent international agreements over the need to reduce greenhouse gases that aim to cut greenhouse gas emissions by 50 percent before 2050, it is crucial that research and implementation of Renewable Energy (RE) sources should be made a priority. This study addresses the key stakeholders involved in the supply chain of domestic RE to identify the challenges and opportunities in the implementation of RE in the UK. The methodology involves a survey to customers to identify the reason for implementing, or not, renewable energy technologies in their homes. The results indicate that financial constraints, lack of information, and public acceptance are the main issues that need to be addressed. Therefore, to encourage the adoption of RE, the cost should be subsidised, or addressed via affordable means, to enable consumers to be engaged with clean technologies considering the recent rising costs of electricity.

Keywords: Renewable Energy; Solar Energy; Wind Energy; Public Engagement; Supply Chain; NetZero.

1. INTRODUCTION

Energy consumption is a recognised global issue, and with the increasing population, there has been a rapid increase in the production of energy to meet the ever-growing demand [1]. The world's energy sources consist mainly of fossil fuels and Renewable energy (RE).

However, there is an over-reliance on fossil fuels, which are depletable [2]. One of the solutions to ensure that the world's fossil fuels do not damage the environment is the implementation of renewable sources of energy [3]. However, considering the recent international agreements by G8 countries over the need to reduce greenhouse gas emissions by 50 percent before 2050, it is imperative that initiatives be taken to implement RE to encourage the progress to Net zero [4]. Similarly, there are many similarities between Net zero emissions and climate neutrality in terms of the concept. When greenhouse gases, such as carbon dioxide (CO₂) and methane, are reduced through reduction measures, net zero emissions will result [5]. The RE program in the UK has been ongoing for over 20 years since its launch in 1973/74 following the oil crisis [6]. The recent years have seen renewables gain importance from being minimal to becoming an extensive energy option in the UK and worldwide [8; 9]. However, the recent emergence of Covid-19 could prove to be a hinderance in the implementation of RE [10; 11; 12; 13]. The measures adopted by individuals, firms, and states in reaction to the unexpected global crisis has compelled a series of economic, social, and political changes that are likely to influence sustainable energy transitions [14]. As a result, the UK has recently taken actions regarding the impacts of Covid-19 to the RE sector. These actions involve introducing a Renewable Heat Incentive (RHI) scheme which will enable hundreds of thousands of homeowners to receive vouchers of up to £5000 to perform energy saving home improvements [15]. Despite the RHI's contribution to both the UK's renewable energy target

and to its decarbonisation targets, this reform aims to promote the deployment of the appropriate technologies for the intended purposes [16]. Several measures are available, and these are divided into primary and secondary measures. However, at least one primary measure must be installed with the voucher. For instance, a low carbon heating system such as solar thermal or air source heat pump could be used for low carbon heating and loft or wall insulation for home insulation [16]. However, evidence suggests that in the implementation of RE sources such as solar energy, some factors need to be considered. One of these factors include the structural capability of the existing roof of the primary structure in most homes [17]. This is considered a key factor because RE systems can in themselves add a considerable amount of load onto a roof which can also be influenced by positive and negative wind loads depending on the local geographical conditions [18]. As the UK strives to meet its target of producing 100% of its electricity from renewables by 2025, it is paramount to investigate the importance of RE to enable the UK to meet the set targets and analyse the issues that may be hindering the implementation of renewables in the UK. This paper explores the analysis of one of the stakeholders involved in the supply chain of RE using a holistic approach to provide recommendations.

The research questions include:

1. What are the main barriers to consumers use of RE?
2. What are the factors that can influence the use of sustainable energy in homes?

The aim is to enhance public engagement in utilising renewable energy, particularly solar energy, in their homes.

2. RESEARCH METHODOLOGY

The research methodology used in this paper is quantitative data research technique. This study utilised a method described as convenience sampling to collect the data. According to [19], this technique involves selecting participants randomly to eliminate bias. The questionnaire is aimed at understanding the reasons hindering consumers from adopting RE. In this study,

sections of the questionnaire were developed to examine the reasons for the overreliance on oil, and how variables such as education background, price, age, and gender influence an individual's decision to switch to sustainable energy sources and how those factors influence the outcome. The survey was distributed through an online platform in the UK and generated 620 responses. Subsequently, the questionnaire was distributed in January 2022 until August 2022. In that specified time, the energy price cap in the UK had increased from 4.1p/kWh (pence per kilowatt hour) of gas to 8p/kWh and 20.8p/kWh of electricity to 29p/kWh [20]. The survey was completed without any element of discrimination towards ethnicity, gender, and areas of residence of the respondents in the UK. To ensure this study is free of bias, a 50/50 male to female ratio is ideal. However, this study has a majority of female respondents with 74% and 26% male. Furthermore, the response rate of the questionnaire was 89% as 700 questionnaires were distributed, and 620 responses were returned. This method provides insight into the key factors that are impacting the growth of domestic renewables from a consumer's perspective. This would also enable feasible recommendations to be established. Figure 1 presents an example of a house with installed PV solar energy panels.



Fig. 1. The paper investigates the reason for implementing, or not, renewable energy technologies in the residential sector.

3. THEORETICAL FRAMEWORK

There are several factors that influence consumers in the adoption of RE sources. These include public acceptance [21; 22], financial constraints [23], environmental concerns [24], and lack of awareness [25]. According to

[22], to improve public acceptance, an effective policy is required because studies show that there is a relationship between RE acceptance and social norms [26]. Other key factors include consumers reluctance due to the cost of renewables and the resulting financial constraints, and the urge to adopt RE sources to preserve the environment [27; 28].

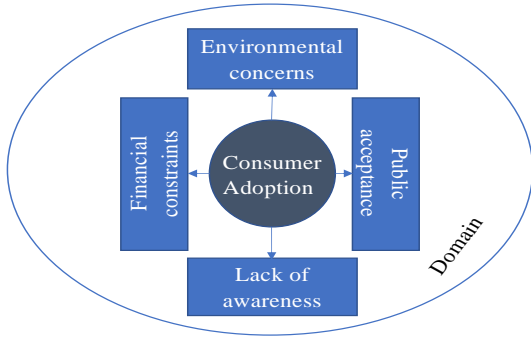


Fig. 2. Theoretical framework for RE consumer adoption.

Figure 2 presents a theoretical framework for RE consumer adoption. This theoretical framework was designed using the behavioural reasoning theory (BRT) developed by James Wetasby. Additionally, a strong connection can be made between the reasoning component and the seminal theories of reasoning, namely, the reasons theory [29] and the explanation-based decision-making theory [30]. Furthermore, several variables have been previously adopted to examine relationships between BRT constructs. These include beliefs and values [31], economic and financial benefits

[32; 33], budgetary constraints [34], environmental awareness [35], and environmental benefits [32; 33].

4. RESULTS AND DISCUSSION

Some results of the analysis of the questionnaire are discussed in this section. The respondents all reside in the UK either permanently or temporarily with 98% and 2% respectively. Additionally, the respondents aged 18-24 represented 10% of the returns, 25-34 represented 33% of the returns, 35-44 represented 25% of the returns, 45-54 represented 17% of the returns, 55-64 represented 12% if the returns, and age 65 or over, represented 3% of the returns. Regarding the qualification of respondents, 18% of the respondents have achieved a post graduate qualification with 2% for doctorate and 16% for masters respectively. Respondents who achieved a bachelor’s degree represented the largest proportion of the respondents with 42%, while 23% achieved a secondary school certificate, diploma 16%, 1% achieved a primary school qualification, and respondents who specified other accounted for 1% of the returns. The occupation of the respondents shows that 7% of the respondents are students, 8% are civil servants, 5% are teachers/lecturers, 10% are self-employed, 5% are retired, 3% are freelancers, 35% are private sector employees/directors, 12% are unemployed, and 16% of respondents account for other such as mental health worker, public sector manager, and NHS physiotherapist.

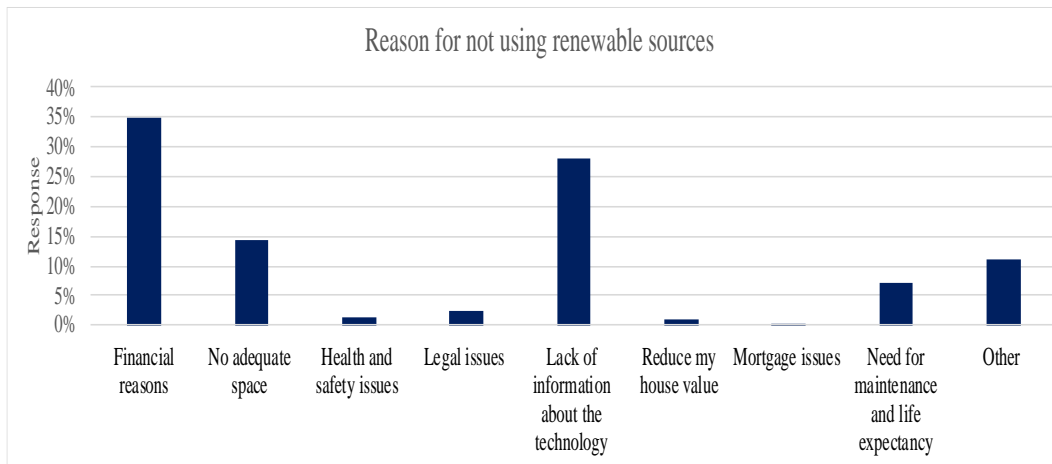


Fig. 3. Reasons for not adopting renewables.

Depicted in figure 3, 35% of the respondents stated that financial reasons were hindering them from adopting renewables. This was closely followed by the lack of information about the technology with 28% of respondents. Another notable response was the selection of no adequate space with 14%. These highlighted reasons shows that the findings agree with literature which states that financial constraint and lack of information are key factors in the implementation of RE [36; 37; 38].

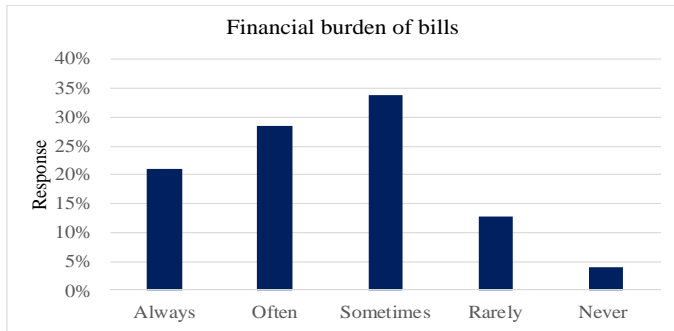


Fig. 4. Financial burden of bills.

Figure 4 shows the respondents’ reaction to the financial impact of electricity bills on them. Majority of the respondents stated that the cost of electricity was either always a burden, often a burden or sometimes a burden with 21%, 29%, and 34% respectively. This shows that the financial impact of the rise of energy bills in the UK is evident. This result is expected to increase further following the recent increase in energy prices.

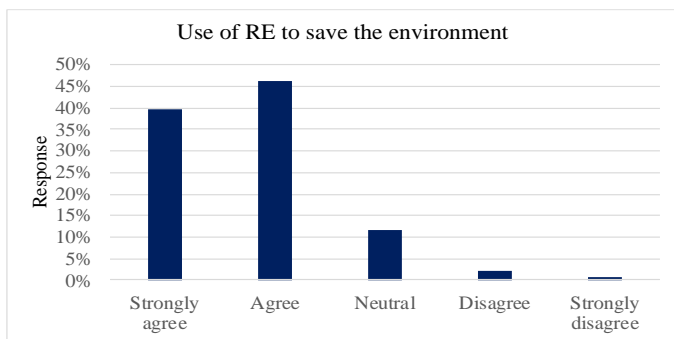


Fig. 5. Use of RE to save the environment.

As displayed in Figure 5, respondents firmly agree on the issue of preserving the environment with 40% stating they strongly agree, 46% stating they agree, and the respondents that stated they are neutral, or disagree, or strongly disagree have 12%, 2%, and 1% respectively.

This also agrees with literature with respondents stating that they are aware of the adverse effects of fossil fuels on the environment [39].

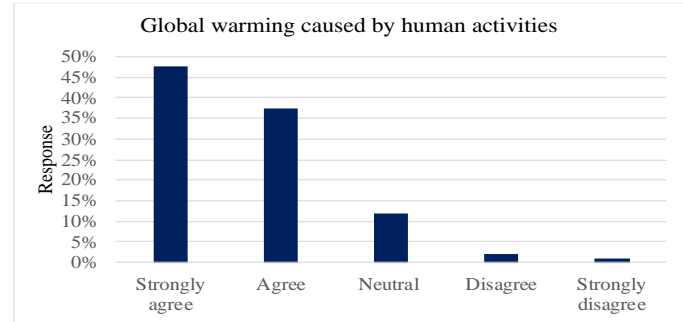


Fig. 6. Global warming caused by human activities.

Depicted in Figure 6 is the perception of the respondents on the impact of human activities to the rise in greenhouse gas emissions. Majority of respondents stated that they strongly agree with 48%, and 37% stating that they agree. However, the number of respondents that are neutral, disagree, or strongly disagree was 12%, 2%, and 1% respectively. This contradicts the literature which identifies the lack of awareness and understanding of global warming as one of the reasons impeding the adoption of renewables from consumers [40].

5. CONCLUSIONS

This study confirms the challenges that are preventing a better public engagement in renewable energy in the domestic environment. The recent increase in energy prices is expected to enhance the interest in renewable energy further. However, the challenges that limit public engagement in the use of domestic renewable energy include mainly financial constraints, lack of information about RE sources, public acceptance and practical or technical factors such as the lack of adequate space (e.g. roof space) to install solar panels. However, findings from this study have also shown that consumers are aware of the impact of their activities on the environment which somehow contradicts previous literature which states otherwise. This is an indication that the society in the UK is aware of the necessary steps needed to achieve Net-zero. Evidently, to improve acceptance of renewables to consumers, schemes should be made available to subsidise renewable energy

to enable consumers' affordability considering the impact of the rise in energy bills.

DECLARATION OF INTEREST STATEMENT

The authors declare that there is no conflict of interest including any financial, personal, or other relationships with other people or organizations that could inappropriately influence, or be perceived to influence, their work.

REFERENCE

[1] Cerovi, L. and Maradin, D., 2014. From the Restructuring of the Power Sector to Diversification of Renewable Energy Sources: Preconditions for Efficient and Sustainable Electricity Market. *International Journal of Energy Economics and Policy*, 4(4), pp. 599-609 [Accessed 20 July 2023].

[2] Greiner, P., York, R. and McGee, J., 2022. When are fossil fuels displaced? An exploratory inquiry into the role of nuclear electricity production in the displacement of fossil fuels. *Heliyon*, 8(1), p.e08795 [Accessed 20 July 2023].

[3] Rahman, S. and Miah, M. (2017). The impact of sources of energy production on globalization: Evidence from panel data analysis. *Renewable and Sustainable Energy Reviews*, [online] 74, pp.110-115. Available at: <https://www.sciencedirect.com/science/article/pii/S136403211730254X> [Accessed 24 May 2023]

[4] Shah, I., Hiles, C. and Morley, B. (2018). How do oil prices, macroeconomic factors and policies affect the market for renewable energy? *Applied Energy*, 215, pp.87-97 [Accessed 15 August 2023].

[5] Matemilola, S. and Salami, H., 2020. Net Zero Emission. *Encyclopedia of Sustainable Management*, pp.1-6 [Accessed 15 August 2023].

[6] Batley, S., Fleming, P. and Urwin, P., 2000. Willingness to Pay for Renewable Energy: Implications for UK Green Tariff Offerings. *Indoor and Built Environment*, 9(3-4), pp.157-170 [Accessed 20 July 2023].

[7] Zakariah, M., 2012. Oil, War and European Initiatives for Peace in the Middle East 1973-74: British Attitude and Perspective. *Middle Eastern Studies*, 48(4), pp.589-611 [Accessed 15 August 2023].

[8] Gross, R., Leach, M. and Bauen, A., 2003. Progress in renewable energy. *Environment International*, 29(1), pp.105-122 [Accessed 20 July 2023].

[9] Demirbas, A., 2009. Global Renewable Energy Projections. *Energy Sources, Part B: Economics, Planning,*

and Policy, 4(2), pp.212-224 [Accessed 20 July 2023].

[10] Naderipour, A., Abdul-Malek, Z., Ahmad, N., Kamyab, H., Ashokkumar, V., Ngamcharussrivichai, C. and Chelliapan, S., 2020. Effect of COVID-19 virus on reducing GHG emission and increasing energy generated by renewable energy sources: A brief study in Malaysian context. *Environmental Technology & Innovation*, 20, p.101151 [Accessed 15 August 2023].

[11] Hoang, A., Nguyen, X., Le, A., Huynh, T. and Pham, V., 2021. COVID-19 and the Global Shift Progress to Clean Energy. *Journal of Energy Resources Technology*, 143(9) [Accessed 20 July 2023].

[12] Bhuiyan, M., An, J., Mikhaylov, A., Moiseev, N. and Danish, M., 2021. Renewable Energy Deployment and COVID-19 Measures for Sustainable Development. *Sustainability*, 13(8), p.4418 [Accessed 21 July 2023].

[13] Kaczmarzewski, S., Matuszewska, D. and Softysik, M., 2021. Analysis of Selected Service Industries in Terms of the Use of Photovoltaics before and during the COVID-19 Pandemic. *Energies*, 15(1), p.188 [Accessed 15 August 2023].

[14] Kuzemko, C., Bradshaw, M., Bridge, G., Goldthau, A., Jewell, J., Overland, I., Scholten, D., Van de Graaf, T. and Westphal, K., 2020. Covid-19 and the politics of sustainable energy transitions. *Energy Research & Social Science*, 68, p.101685 [Accessed 15 August 2023].

[15] Sunak to unveil £2bn home insulation scheme. 2020. *BBC*. [online] Available at: <<https://www.bbc.co.uk/news/business-53313640>> [Accessed 15 June 2023].

[16] Abu-Bakar, S., Muhammad-Sukki, F., Ramirez-Iniguez, R., Mallick, T., McLennan, C., Munir, A., Mohd Yasin, S. and Abdul Rahim, R., 2013. Is Renewable Heat Incentive the future?. *Renewable and Sustainable Energy Reviews*, 26, pp.365-378 [Accessed 28 July 2023].

[17] de Vries, T., Bronkhorst, J., Vermeer, M., Donker, J., Briels, S., Ziar, H., Zeman, M. and Isabella, O., 2020. A quick-scan method to assess photovoltaic rooftop potential based on aerial imagery and LiDAR. *Solar Energy*, 209, pp.96-107 [Accessed 20 July 2023].

[18] Mcrma.co.uk. 2014. *THE FACTORS TO CONSIDER WHEN INSTALLING PV PANELS*. [online] Available at: <https://www.mcrma.co.uk/pdf/MCRMA%20Feb%20RCI%20article%20web.pdf> [Accessed 21 May 2023].

[19] Som, R. K. (1995). *Practical sampling techniques*. CRC press [Accessed 20 July 2023].

[20] ICAEW, 2022. Chart of the week: energy prices. [online] ICAEW. Available at: <<https://www.icaew.com/insights/viewpoints-on-the-news/2022/jan-2022/chart-of-the-week-energy-prices>> [Accessed 15 August 2023].

- [21] Masrahi, A., Wang, J. and Abudiyah, A., 2021. Factors influencing consumers' behavioral intentions to use renewable energy in the United States residential sector. *Energy Reports*, 7, pp.7333-7344 [Accessed 15 August 2023].
- [22] Spandagos, C., Tovar Reaños, M. and Lynch, M., 2022. Public acceptance of sustainable energy innovations in the European Union: A multidimensional comparative framework for national policy. *Journal of Cleaner Production*, 340, p.130721 [Accessed 15 August 2023].
- [23] Owen, A., 2006. Renewable energy: Externality costs as market barriers. *Energy Policy*, 34(5), pp.632-642 [Accessed 15 August 2023].
- [24] Wall, W., Khalid, B., Urbański, M. and Kot, M., 2021. Factors Influencing Consumer's Adoption of Renewable Energy. *Energies*, 14(17), p.5420 [Accessed 15 August 2023].
- [25] Fung, C. C., Tang, S. C., Xu, Z., & Wong, K. P. (2013, July). Comparing Renewable Energy policies in four countries & overcoming consumers' adoption barriers with REIS. In *2013 IEEE Power & Energy Society General Meeting* (pp. 1-5). IEEE [Accessed 15 August 2023].
- [26] Oluoch, S., Lal, P., Susaeta, A. and Vedwan, N., 2020. Assessment of public awareness, acceptance and attitudes towards renewable energy in Kenya. *Scientific African*, 9, p.e00512 [Accessed 15 August 2023].
- [27] Kowalska-Pyzalska, A., 2018. What makes consumers adopt to innovative energy services in the energy market? A review of incentives and barriers. *Renewable and Sustainable Energy Reviews*, 82, pp.3570-3581 [Accessed 15 August 2023].
- [28] Omer, A., 2008. Energy, environment and sustainable development. *Renewable and Sustainable Energy Reviews*, 12(9), pp.2265-2300 [Accessed 15 August 2023].
- [29] Westaby, J.D. and Fishbein, M., 1996. Factors underlying behavioral choice: testing a new reasons Theory Approach 1. *Journal of Applied Social Psychology*, 26(15), pp.1307-1323 [Accessed 15 August 2023].
- [30] Pennington, N. and Hastie, R., 1993. Reasoning in explanation-based decision making. *Cognition*, 49(1-2), pp.123-163 [Accessed 15 August 2023].
- [31] Briggs, E., Peterson, M. and Gregory, G., 2010. Toward a better understanding of volunteering for nonprofit organizations: Explaining volunteers' pro-social attitudes. *Journal of Macromarketing*, 30(1), pp.61-76 [Accessed 17 July 2023].
- [32] Claudy, M.C., Peterson, M. and O'driscoll, A., 2013. Understanding the attitude-behavior gap for renewable energy systems using behavioral reasoning theory. *Journal of Macromarketing*, 33(4), pp.273-287 [Accessed 20 July 2023].
- [33] Claudy, M.C., Garcia, R. and O'Driscoll, A., 2015. Consumer resistance to innovation—a behavioral reasoning perspective. *Journal of the Academy of Marketing Science*, 43(4), pp.528-544 [Accessed 15 July 2023].
- [34] Diddi, S., Yan, R.N., Bloodhart, B., Bajtelsmit, V. and McShane, K., 2019. Exploring young adult consumers' sustainable clothing consumption intention-behavior gap: A Behavioral Reasoning Theory perspective. *Sustainable Production and Consumption*, 18, pp.200-209 [Accessed 20 July 2023].
- [35] Park, M., Cho, H., Johnson, K.K. and Yurchisin, J., 2017. Use of behavioral reasoning theory to examine the role of social responsibility in attitudes toward apparel donation. *International journal of consumer studies*, 41(3), pp.333-339 [Accessed 15 August 2023].
- [36] Rawea, A. and Urooj, S., 2018. Strategies, current status, problems of energy and perspectives of Yemen's renewable energy solutions. *Renewable and Sustainable Energy Reviews*, 82, pp.1655-1663 [Accessed 15 August 2023].
- [37] Cedrick, B. and Long, P., 2017. Investment Motivation in Renewable Energy: A PPP Approach. *Energy Procedia*, 115, pp.229-238 [Accessed 20 July 2023].
- [38] Owusu, P. and Asumadu-Sarkodie, S., 2016. A review of renewable energy sources, sustainability issues and climate change mitigation. *Cogent Engineering*, 3(1), p.1167990 [Accessed 15 August 2023].
- [39] S., Jaafar, N., Sulaiman, A. and Parveen Tajudeen, F., 2020. Feelings of guilt and pride: Consumer intention to buy LED lights. *PLOS ONE*, 15(6), p.e0234602 [Accessed 15 August 2023].
- [40] Leiserowitz, A., 2007. International public opinion, perception, and understanding of global climate change. *Human development report, 2008*, pp.1-40 [Accessed 15 August 2023].