Perspectives of Homeowners on Sustainability and the Design of Energy-Efficient Residential Architecture

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Abstract: The paper presents an investigation into the householder perception of low-energy dwellings. Iraq has an infamous reputation of being a country with an abnormal consumption and emission of carbon dioxide. Therefore, an online survey (398 respondents) was conducted across Iraq to determine their opinion on the knowledge and awareness of sustainability and low energy dwellings. It considers the manners and the characteristics of the current dwellers in terms of energy usage and their understanding of what constitutes sustainable and low-energy dwellings. The results highlight how a lack of householder's knowledge and awareness of low-emission and sustainable energy sources and entrance restrictions have restricted the conversion of current residential stock to contemporary environmentally friendly dwellings.

Keywords: Sustainable Architecture, Low-Energy Design, Architecture design.

1. INTRODUCTION

There are serious environmental challenges on a worldwide scale (ranking from 1 to 24), and the built environment (ranking from 24) may play a key role in mitigating these problems' high negative impacts. fifteen, two, and adopting a model with less environmental contamination 10. From traditional architecture design 23 to more contemporary examples like Gaudi's waste-based architecture design 21, there is a long history of environmentally conscious architectural design. In the past, we've found eco-friendly solutions that are good for society and the wallet. Therefore, the Brundtland Commission Report 5 and subsequent studies offer the most recent comprehensive definition of sustainability, which would deem them sustainable11. Economic, sociocultural, and environmental considerations are all part of this concept (24–34). Numerous studies have focused on a wide range of topics, including technology, government, culture, and more. 9. Passive energy solutions, intelligent façade layers (Böke, Knaack, and Hemmerling, 2019), recycled construction materials, nearly zero-energy buildings, building information modeling, and other eco-friendly architectural design concepts are currently being developed. Nevertheless, in order to choose the most suitable design from among many intriguing possibilities, decision-makers want methods to assess and rank possible solutions and measures. 27. A wide range of options, from highly developed methods created for a particular study to mandatory requirements 6, are available. 7. A number of well-known resources and approaches are available. 20.

The majority of rating systems take a comprehensive approach that considers all aspects. On the other hand, there are others that narrow their attention to just one aspect, such as energy simulations combined with a life cycle assessment that primarily considers the environmental impact. We should rigorously examine academic research on various assessment processes to

identify the most effective strategies for each case. However, most studies have concentrated on one kind of evaluation option, such as optimizations for simulations that lead to sustainable construction. 23. Building carbon emissions 14. Multi-criteria decision-making methods for the construction industry 9.,13,19,25-28. Rating tools. Despite the frequent use of the term "sustainability", sustainable building is still in its early stages (29–31). Emekci (2022) discussed the significance of environmentally friendly building practices throughout a sustainable era. Exhaust gases from human-caused sources increased dramatically throughout the Industrial Revolution. At that point, unsustainable global warming and the resulting sharp rise in atmospheric temperatures started. We must conduct all operations in a "sustainable" manner to address environmental and human health concerns. One of the initial stops on the path to sustainability should be buildings, since they are responsible for a considerable amount of the greenhouse gas emissions in urban areas and since urban areas are believed to be responsible for around 80 percent of the world's greenhouse gas (GHG) emissions. The goal of Emekci 2022 is to highlight the importance of eco-friendly architecture in solving environmental problems and guaranteeing long-term city planning. However, for a variety of reasons, many people around the world struggle to keep up with this practice. Goldwyn et al., 2022, investigated the views on multi-hazard home safety among Puerto Ricans involved in building development. Using measures of energy sustainability, vulnerability, and knowledge, Sovacool et al. (2021) examined the demographics of smart home technology proliferation. Liu et al., (2022), developed a framework for behaviour modification to regulate and prevent pandemics in public spaces in China. In order to ensure long-term viability, researchers prepare for a pandemic by developing a study plan and strategies to get individuals to change their habits. According to their findings, all of the derived factors may in some way influence people's precautionary actions during pandemics. Liu provided many parties with useful advice on what to do in the event of a pandemic.

Consequently, sustainable design issues are still under-discussed in architectural education and training programmes. Simultaneously, numerous studies demonstrate that early design choices significantly impact sustainability. 3, 5, and 8. Designers back then, nevertheless, knew very little about how to make their products eco-friendly. Consequently, designers often make decisions without considering the substantial consequences, relying solely on experience, rules of thumb, reference projects, or intuition. 4,5,8,20. When working on smaller projects without much technical support owing to financial limitations, designers must depend on their own expertise and experience to integrate sustainability into their plans. 25,27.

The purpose of this research is to provide an examination of homeowners' perspectives on the level of sustainability knowledge and awareness in relation to low-energy homes. Furthermore, it takes into account the features and habits of current residents with regard to energy use, as well as their comprehension of what defines sustainable and low-energy housing. Research like this should help policymakers zero in on viable design strategies, narrow down their choices to those that would improve the sustainability of the built environment, and put those strategies into action on a global scale.

The following section provides a detailed account of the procedures used to complete this study. Section 3 details the results and their analysis, while Section 4 describes the findings.

2. METHODOLOGY

A questionnaire was issued to 398 households in Iraq to gather comments and views on their knowledge and understanding about environmental sustainability and low-energy dwelling. Upon examining Adam's (2006) focus group methodology, we deduced that unstructured interviews may yield excessive data from respondents, rendering full analysis impossible due to word constraints. Therefore, we will replace interviews with structured questionnaires to facilitate more organised responses and insightful analysis. We will also employ an online questionnaire following an assessment of current methodologies. Respondents can easily and

quickly respond to questions through online surveys, eliminating the need for additional work after completion.

Furthermore, an online questionnaire saves time and money by immediately communicating responses to the researchers. You can create the survey questionnaire for free on various questionnaire creation websites, such as "surveymonkey.com." The questionnaire will incorporate tick-box and ranking questions, presenting the responses as numerical results for analysis; this constitutes quantitative data. Additionally, respondents have the freedom to freely express their thoughts on the questions, revealing information that is visible but not quantifiable; this constitutes qualitative data.

3. RESULT ANALYSIS AND DISCUSSION

A total of 450 individuals completed the survey, with 398 (88.4%) providing satisfactory responses and completing all the required questions. We conducted an online survey in Iraq with 398 participants to evaluate their knowledge and understanding of sustainability and low-energy homes. The study examines current occupants' energy consumption patterns and characteristics, as well as their perceptions of the key features of sustainable and energy-efficient housing.

All 398 respondents, who lived in both traditional and contemporary dwellings, were asked the following question:
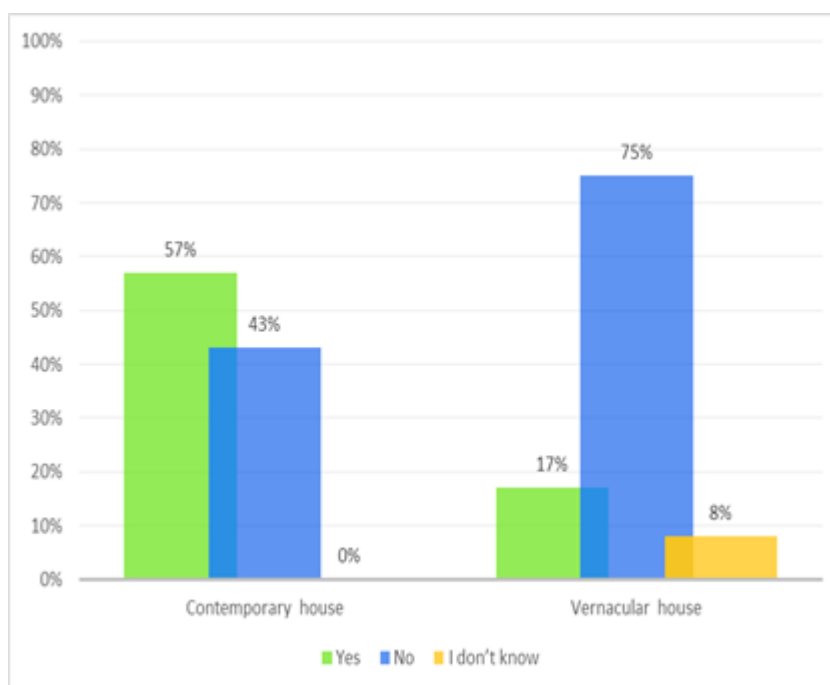

Figure 1: knowledge about homes that are energy-efficient

Question 1 was designed to gather information on the respondent's knowledge and experience with low-energy dwellings. It was comprised of two subsections. The first paragraph aimed to determine the proportion of respondents who were familiar with low-energy housing, while the second subsection aimed to confirm the costs associated with constructing such houses.

The data from Figure 1 indicates that 47% of the respondents had no knowledge about low-energy homes. In contrast, our findings revealed that 52% of the participants were knowledgeable about low-energy homes. According to Figure 1, 57% of respondents in the modern region had a good degree of knowledge about exceptionally energy-efficient dwellings. However, a minority of those who participated (43%) report a lack of expertise. People who watch visual media and participate in social activities are likely to have a higher degree of knowledge and awareness regarding residences that are very energy-efficient. Certain people have acquired specialised knowledge in the areas of environmental sustainability and energy design.

According to Figure 1, 75% of participants living in vernacular dwellings do not understand low-energy housing. Individuals are unaware of the impact that offering sustainable home design could have on their own lives. As a result, learning more about low-energy design through other media platforms may be beneficial.
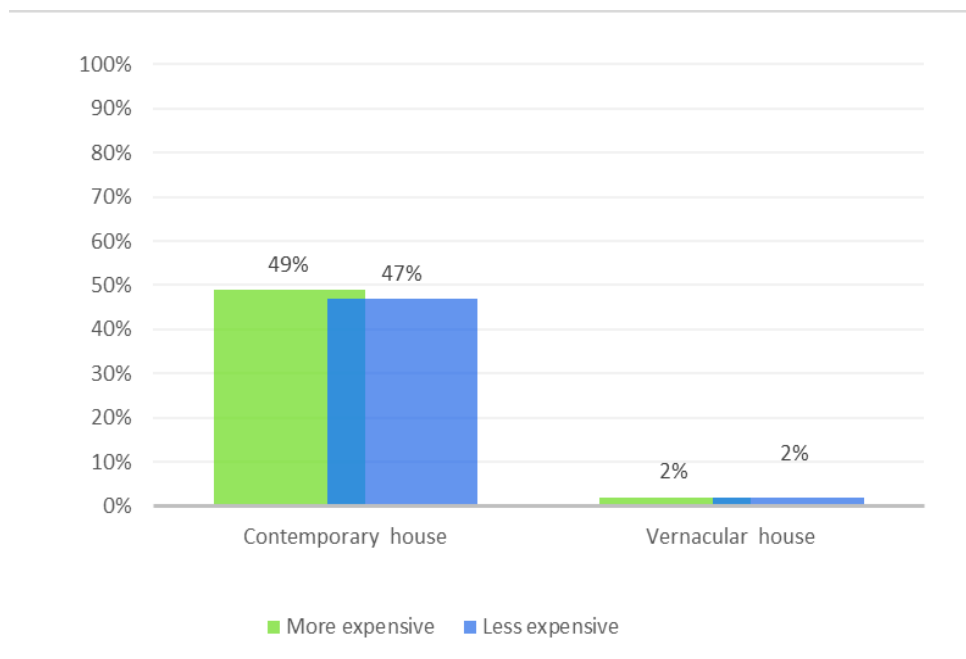
| Answer	Reasons
More costly **(51%)**	• Requires specialised materials. • Construction materials are excessively expensive. • Adoption of new technologies is required. • Importing building supplies increases the cost.
Less costly **(49%)**	• Over time, the effects of applying different architectural ideas become apparent. • It depends on using natural resources.

Figure 2: The price tag associated with building an eco-friendly, low-energy dwelling.

In the second half, we found that 51% of respondents who answered yes in question 1A thought low-energy residences were more expensive than their current ones, while 49% thought they were cheaper. Additionally, they referenced the reasons outlined in Figure 2. Figure 2 depicts the respondent's rationale for the potential cost difference between a sustainable house and a conventional residence.

The objective of the second question was to ascertain if those who responded agreed with the notion of advocating for sustainable, energy-efficient architectural designs. Figure 3 provides solid evidence that 96 percent of participants are willing to endorse sustainable, low-energy homes in Iraq in the future.
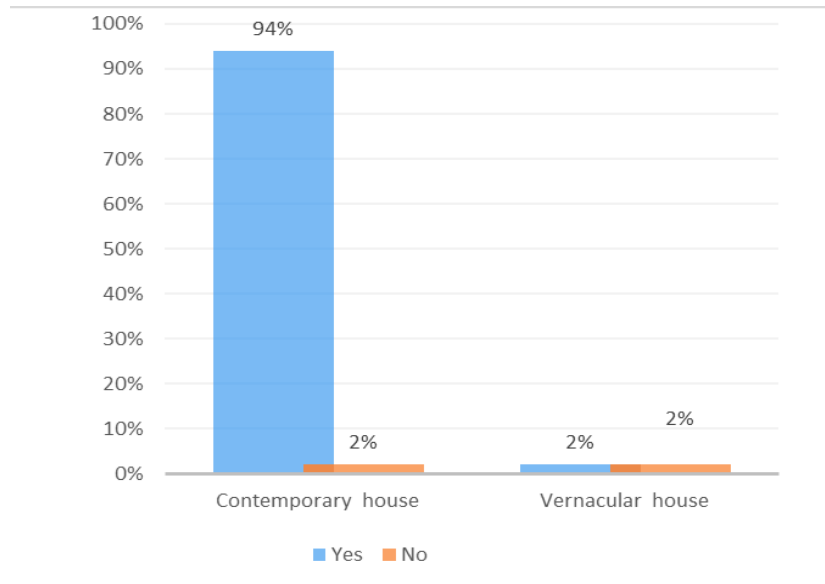
**Figure 3**: Possible future use of energy-efficient housing

The respondents who had answered yes to the question 2 (96%) regarding vernacular homes and contemporary houses were asked an additional question, which was as follows:
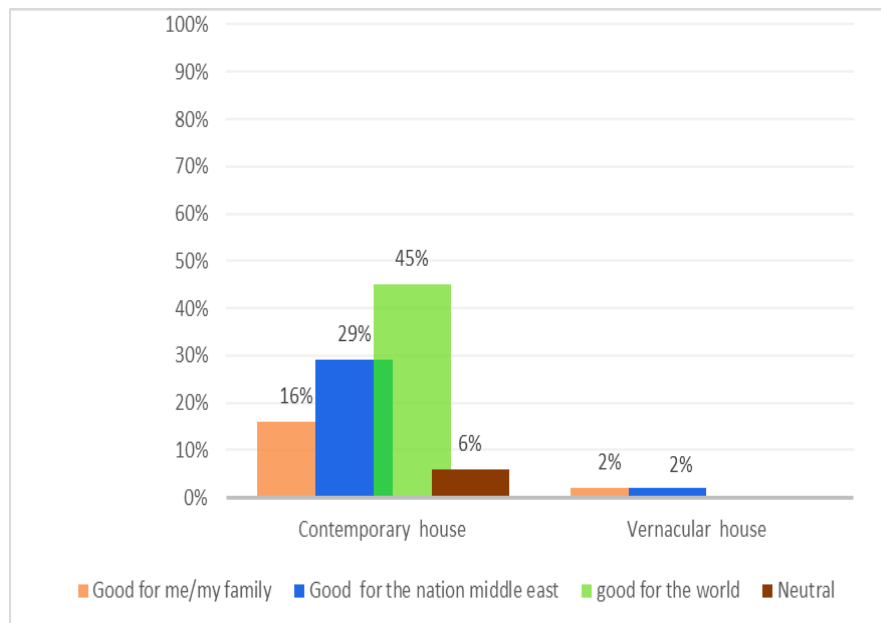
Figure 4: The reasoning for the benefits of a sustainable residence

Nearly all respondents (96%) who selected "yes" in question 2 said that sustainable, low-energy homes may benefit their loved ones, the region around them, or maybe the whole planet. Figure 4 summarises this discovery. Some 52% of those who were surveyed were aware of the benefits of eco-friendly homes.

In order to gauge people's levels of approval for design elements of house retrofitting for improved sustainability and energy efficiency, the following question looks at the replies (398).
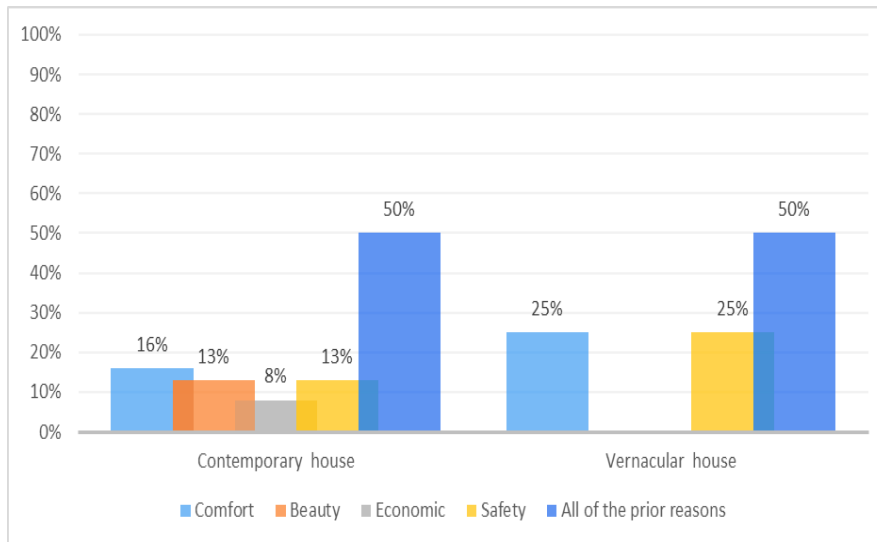
**Figure 5:** Requirements for the future dwelling

Question 4 aimed to gauge respondents' expectations about future house necessities. With 42% of the total votes (Figure 5), the modern home prioritised security, aesthetics, and comfort. On the other hand, comfort and safety accounted for half of the alternatives in the traditional home. This proves that the people living in both houses are looking for similar characteristics in a future house, and that the suggested standards would be good for everyone living in Baghdad. The results in Figure 5 clearly show that half of the people surveyed in both households chose all of the explanations given.

Finding out how open people were to incorporating low-energy design elements into their houses was the major motivation for conducting the poll. Figures 6 and 7 show the results of the analysis that followed when respondents were asked about potential energy-saving methods in this particular question.
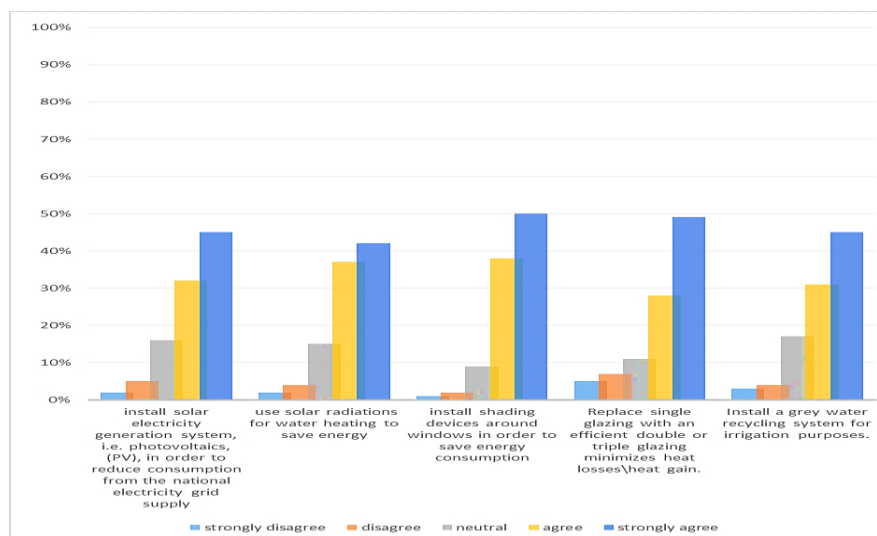
Figure 6: Expectations of respondents on upcoming energy-saving measures for homes

Figure 6 shows that more than 32% of respondents felt that households should install PV systems to generate energy, with 45% feeling this way strongly. A variety of perspectives and methods are shown in Figure 6 to promote eco-friendly and energy-efficient housing. The group reached a consensus that replacing electrical power produced by fossil fuels with solar (renewable) energy for hot water tanks is an effective way to lower energy use. In addition, as seen in Figure 6, respondents felt that dwellings with coverings around windows or light sources tended to stay cooler naturally and automatically, decreasing the need for cooling systems.
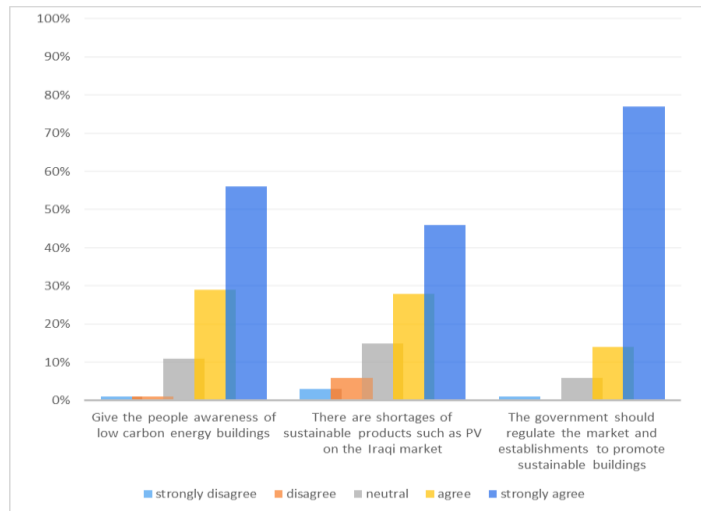
Figure 7: Action taken by the government to cut down on the use of energy in future homes

Last but not least, Figure 5 shows that more than 87 percent of respondents either strongly agree (57 percent) or agree (30 percent) that a lack of knowledge about energy-efficient buildings increases energy use because people are less aware of the consequences. The availability of things that are both accessible and sustainable is limited, and respondents believe that the government needs to play a more aggressive role in promoting awareness and improving their availability.

After that, the follow-up question, number 6, inquires about the thoughts of respondents on the design of future houses.
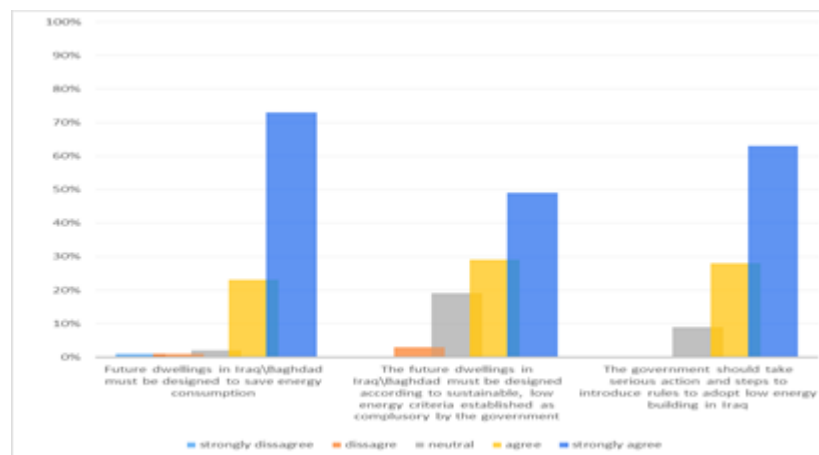
Fig. 8: In the future, this research aims to examine the attitudes of Iraqi households to the adoption of energy-efficient and environmentally friendly buildings.

The good news about residential building design is that, as shown in Figure 8, 96% either agreed (73%) or agreed (23%) about the need to include design elements that reduce energy consumption and, in the long run, eliminate CO2 emissions. So, it's important to build Baghdad's homes with energy efficiency and carbon emission reduction in mind.

The public at large is open to adopting more sustainable practices, but they anticipate pushback because of how slowly things will change. Twenty percent of those who took part in the study think it's conceivable, but very unlikely, that building less is feasible since solar systems are so easy to set up (Figure 8). In contrast, 91% of those who took the survey said that elected officials and those in authoritative positions, such as ministries, should take action to reduce energy use. This proves that:

- Sustainable, low-energy housing is known to 52% of the population. However, in contrast to vernacular housing, 43 percent of respondents in contemporary housing are unfamiliar with green, low-energy dwellings. Therefore, we should prioritise the need to teach individuals how to make their houses more sustainable.

- Among those who were aware of low-energy homes, 51% stated they were costlier than their current home, while 49% answered the opposite.

- Nearly all respondents (94%) are familiar with the concept of sustainable, low-energy housing and think it may benefit their loved ones, the region around them, or the world at large.

4. CONCLUSIONS

This artwork showcases the local population's vision of sustainable housing in Baghdad. The inquiry focuses on analysing the elements that lead to higher energy consumption and identifying potential cultural obstacles that hinder the development of energy-efficient houses. To gather public opinions, we conducted a survey. The participants in the study had different educational backgrounds and were of different ages. In summary, the researchers' results uncovered a range of variables that lead to increased energy use in families in Baghdad. The researchers thoroughly analysed these concerns to provide supervisory guidance on practical solutions that could potentially reduce energy usage and minimise CO2 emissions associated with building design. In addition, the research has identified certain cultural obstacles that hinder the development of residences in Baghdad with long-lasting sustainable characteristics, which were previously undisclosed. As a result, this chapter presents both feasible recommendations and corresponding solutions while also examining the environmental, sociocultural, and economic benefits, as well as the consequences of each approach.

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