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Sustainable energy adoption in UAE homes (villas and apartments)

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Introduction: Global warming is a major 21st-century challenge, requiring a shift toward sustainable lifestyles—especially in how homes are designed and powered. This study investigates the factors shaping household adoption of residential solar (renewable energy) in the UAE, where buildings (including housing) account for nearly 80% of total electricity consumption. Understanding what drives UAE residents to adopt renewable energy at home is essential for accelerating sustainable housing and supporting climate-change mitigation.
Methods: A quantitative, cross-sectional survey was conducted using a structured questionnaire targeting UAE households. Data were analyzed using factor analysis in SPSS. The initially calculated sample size was 73; of 90 respondents, 82 valid responses were included in the final analysis.
Results: The findings show that economic benefits are the strongest motivator for adopting renewable energy in residential settings. The study provides a quantified ranking of adoption motivators: economic benefit (~41.8%) as the primary factor, followed by government role (~17%), and climate-risk awareness (~6.4%). Overall, four extracted factors explain approximately 82.4% of the total variance.
Discussion: The study's key contribution is the quantified ranking and relative weight of household adoption drivers in the UAE—an evidence granularity that is not commonly reported in prior UAE research. These results provide actionable direction for policymakers and practitioners: strengthening financial attractiveness and enabling government mechanisms appears most influential, while awareness-related drivers play a smaller (but still relevant) role. The findings also indicate that additional determinants likely exist beyond the extracted factors, supporting further research to identify other barriers and enablers for wider deployment of renewable energy solutions across UAE housing types (villas and apartments).

KEYWORDS

diffusion of innovation, environmental attitudes, household solar adoption, perceived cost–benefit, policy incentives, residential photovoltaics

1 Introduction

As part of a national contribution in accordance with commitments made by most countries worldwide to adopt green energy, the goal is to promote a sustainable built environment—encompassing all human-made places where individuals live, learn, work, and move, such as buildings, streets, parks, and infrastructure. The

emphasis on sustainability pertains to fulfilling current needs without compromising the opportunities of future generations; this principle is applied to the design, construction, operation, and decommissioning of buildings. Household decisions concerning Renewable Energy play a significant role in influencing future emissions and electricity consumption.

Climate change, among other factors, poses a serious danger to the advancement of sustainability (Abbass et al., 2022). The United Nations has published on its official website explaining climate change, where it says it is a long-term change in weather and temperature trends, and the most recent 10 years (2011–2020) were the warmest ever (What Is Climate Change, 2025). Burning fossil fuels releases greenhouse gases that blanket the atmosphere and intensify climate change—whether it's coal or gasoline used to heat buildings and homes (Dhillon and von Wuehlisch, 2013; Tol, 2018). While some early effects of climate change may seem beneficial, the long-term consequences overwhelmingly threaten sustainability and future generations (Alkhaldi et al., 2023). Rising temperatures are melting polar ice and raising sea levels, endangering coastal zones (Obaideen et al., 2021); in tropical regions, rainfall has dropped by about 80 mm, triggering desertification, coastal flooding, water scarcity, and altered crop patterns (). Changes in precipitation—including shifts in snowfall timing, volume, and year-to-year variability—may exceed forest ecosystems' adaptive limits, leading to local extinctions and reduced carbon storage capacity (Olga, 2018). In this context, the built environment—especially housing—plays a critical role. Residential buildings are among the largest consumers of energy and contributors to CO_2 emissions, particularly in regions with high cooling demands like the UAE. The built environment within the United Arab Emirates (UAE) accounts for 70% of energy consumption, primarily attributable to cooling requirements. This is significantly higher than the global average of 40% (IEA, 2025). Additionally, it is responsible for approximately 35% of the UAE's energy-related CO_2 emissions, predominantly due to the use of air conditioning and appliances in villas and apartments (Khondaker et al., 2016). Consequently, the residential sector emerges as a crucial focus for demand reduction and the implementation of on-site renewable energy generation. Transitioning to Renewable Energy offers a powerful way to curb these emissions. Therefore, improving housing energy performance through Renewable Energy integration is essential for climate mitigation. Consequently, it is urgent to accelerate the integration of Renewable Energy sources to mitigate these effects and safeguard a sustainable future.

Despite strong national sustainability policies and excellent solar potential, residential adoption of renewable energy technologies in the UAE remains low because the key behavioral, economic and institutional barriers at the household level are not yet clearly identified or quantified.

Thus, this study main objective is to identify and quantify the key drivers of household renewable-energy adoption in the UAE using a cross-sectional survey (82 validated responses) and factor-analysis-based modeling to determine which motivators most strongly predict adoption intention to fill the gap related to the limited and fragmented household-level evidence regarding the specific motivators that drive renewable-energy adoption in the UAE. As few studies have reported comparative effect sizes among financial, governmental, and climate-risk factors. That can accelerate Renewable Energy uptake in the UAE, delivering practical insights for industry professionals, policymakers, and local authorities. In order to achieve the objective this research employed a research design and methodology that utilizes a structured questionnaire; incorporating reliability assessments and factor analysis with a regression test to determine effect sizes.

2 Literature review

This review pointed to the Renewable Energy in UAE Housing as a Pillar for Sustainable Transition. beside that it covers three main driver groups for household renewable -energy adoption: (i) Economic & Social (cost, payback, visibility/peer effects), (ii) Government Role (policy design, trust, ease), and (iii) Climate-Risk Awareness (knowledge, salience, fear). This study focused on residential decisions and priorities UAE/GCC evidence where available. Each subsection concludes with an outcome that directly supports the study constructs and hypotheses.

2.1 Renewable energy in UAE housing: a Pillar for Sustainable Transition

Since the 1992 Rio summit, major conferences in Kyoto (1997), Copenhagen (2009), Paris (2015), and Glasgow (2021) have set global targets for cutting CO_2 emissions and advancing sustainable development. These agreements require all nations to reduce greenhouse gases and adopt renewable energy—developed countries leading innovation and financing, while emerging economies balance growth with decarbonization. The principle of "common but differentiated responsibilities" recognizes that contributions vary according to historical emissions and economic capability (ElAlfy et al., 2020).

As a leader in sustainability and energy worldwide, the United Arab Emirates (UAE) has taken decisive action to meet these international obligations (Alkhaldi et al., 2023). The UAE has made significant investments in carbon capture technologies, green hydrogen projects, and solar energy (such as the Mohammed bin Rashid Al Maktoum Solar Park) despite having an oil-rich economy (Obaideen et al., 2021). Its position as a link between proponents of Renewable Energy and conventional energy producers was further cemented in 2023 when it hosted COP28 (Maniruzzaman and Al-Saleem, 2025). The UAE's dedication to striking a balance between environmental stewardship and economic growth is demonstrated by its Net Zero by 2050 Strategic Initiative (Burt, 2023).

Housing is a central component in achieving these energy goals. In the UAE, residential energy demand, particularly from air conditioning, accounts for nearly 70% of household electricity consumption (Save nearly 30 per cent, 2025). Integrating solar PV systems in residential buildings could save an estimated 4.5 million tons of CO_2 annually by 2030, according to the Dubai Renewable Energy Strategy (Dubai's, 2025). Moreover, the inclusion of energy-efficient design and materials in housing not only reduces environmental impact but also enhances indoor comfort and reduces long-term utility costs. The UAE exemplifies how resource-rich countries can spearhead the shift to a sustainable future by

establishing stringent efficiency standards and pioneering smart cities like Masdar City.

Ultimately, mitigating climate change requires unified yet tailored actions from all countries. The UAE's proactive policies from diversifying its energy mix to funding global sustainability projects show that even hydrocarbon-dependent economies can drive meaningful change. As climate impacts intensify, nations must move beyond pledges to enforceable policies, cross-border collaborations, and equitable climate financing. The UAE's journey offers a blueprint for merging economic ambition with planetary responsibility, proving that sustainability and prosperity can and must go hand in hand (Climate Neutrality a National Priority, 2025; News And Media, 2025; Future Economy, 2025).

In contrast, housing challenges in many other regions—including lack of incentives, low awareness, or limited financing—continue to hinder the integration of renewables at the household level. Addressing these barriers is crucial to meet global climate targets. Unlike the UAE, many countries face several challenges obstructing progress toward achieving sustainability. These challenges include insufficient funding for the implementation and planning of sustainable development, conflicts between government investments in sustainable technologies and immediate profit-seeking objectives. Additionally, external factors such as natural disasters like earthquakes and tsunamis have the potential to disrupt sustainability efforts by altering water flow patterns and damaging critical infrastructure. The presence of corruption within institutions and the insufficient promotion of municipal-level initiatives further compound the obstacles in the pursuit of sustainability (Olga, 2018).

2.2 Economic & social drivers of household adoption

Promoting and working towards sustainability are undoubtedly noble goals. However, it's important to recognize that achieving a sufficient level of sustainability is a complex and ongoing endeavor. While societies are increasingly recognizing the significance of sustainability, substantial efforts are required before reaching a satisfactory level of sustainability. It's crucial to understand that sustainability cannot be achieved instantly or effortlessly; instead, it entails the adoption of both short and long-term objectives encompassing environmental, economic, and social aspects, all of which are integral components of human advancement as emphasized by (ElAlfy et al., 2020). The prospects of attaining sustainability fluctuate over time, influenced by evolving circumstances. Take Europe, for instance, where the goals of housing renovation policies, in the context of sustainability, have undergone shifts in response to societal changes as highlighted by (Desvallées, 2022). Notably, there has been a recent emphasis on enhancing the energy efficiency of existing buildings, driven by the growing awareness and concern regarding climate change as reported by (Baek and Park, 2012). Sustainability varies across different sectors, encompassing areas such as construction, transportation, agriculture, the economy, industry, and even individual behavior. In the context of individual behavior, the United Nations Organization outlines several actions that people can take to contribute to the achievement of sustainable development goals. For instance, individuals can help reduce global warming by using public transportation or cycling, donating excess belongings, minimizing food waste, supporting local farmers, ensuring vaccination for themselves and their families, advocating for children's education, conserving water, utilizing energy-efficient appliances, recycling materials, reducing plastic usage, planting trees when feasible, and engaging in various other sustainable practices (How can an individual contribute, 2023).

The key contributors to advancing sustainable development go beyond the scope of establishing environmental regulations. They also cover the adoption of sustainable development principles by society, as well as by economic and political decision-makers. Furthermore, it is crucial to encourage a shift in people's social and psychological perspectives, promoting values and lifestyles that are less centered around materialism as investigated by (Brizga et al., 2014). The Paris Agreement has defined a comprehensive, long-term goal to reduce the risks of climate change, and this goal will be supported by the collective efforts of all participating parties. The author in Savaresi (2016) explored the agreement details showing how it outlined a systematic process for reporting on the actions of individual parties and for reviewing those actions both at an individual level and collectively.

Consequently, economic benefits are also a concern related to sustainability (Ekins and Zenghelis, 2021). The authors in (Song et al., 2017) said that companies usually view input of environmental practices as a cost with no obvious return due to the external implications of environmental management. Businesses will not take the initiative to protect the environment for the long term if the investment merely results in higher expenses. In the same context, the authors in Adewole (2024) found that, businesses will aggressively support their duty to safeguard the environment if environmental protection may result in economic rewards, feeling that environmental preservation and economic interests are compatible.

Buildings are also part of the scene; economic benefits are a clear driving force toward sustainable practice in buildings (Rheude et al., 2021). In facility management, the advantages of sustainability and green construction techniques are starting to be recognized. The authors in (Song et al., 2017) have outlined that to support sustainable practices and assumed their favorable impact on the bottom line, it is possible to quantify and present to an organization's leadership the reduction in energy consumption, productivity gains, waste reduction, and many other positive benefits of sustainability and thus a low-cost service bills.

Public policy, economic performance, and all sectors of trade and industry are profoundly influenced by the banking and finance sector. These financial aspects play a crucial role in determining whether society is successful in pursuing an environmentally sustainable path (Ye and Dela, 2023). It's noteworthy that, as highlighted by the authors in (Jeucken, 2010), professionals in the fields of research and policy often underestimate the significance of the financial sector in advancing sustainable development. Conversely, individuals within the financial sector frequently lack awareness of the rationale behind sustainable development, the challenges it encounters, and how these factors intersect with their roles. In a related vein, the authors in (Carnicer and Peñuelas, 2012) conducted research indicating that the annual economic costs associated with global sustainability regulations

aimed at enhancing sustainable development are three times smaller than the annual global financial flows, which are insufficient to meet sustainability goals. They proposed a potential solution—an incremental global tax of 0.05% on financial transactions—to secure the necessary funding for the implementation of Renewable Energy initiatives. Furthermore, as discussed by (Schwerhoff and Sy, 2017), funding Renewable Energy projects in Africa, for example, presents significant challenges. Sustainable development objectives serve as a benchmark for equitable and sustainable progress, helping to identify the synergistic benefits resulting from the adoption of Renewable Energy solutions. Moreover, significant attempts have already been undertaken to fund the greater cost of Renewable Energy and an analysis of possible leverage points, tools, and relevant parties shows that there is a substantial amount of untapped potential. Consequently, some scholars have investigated some effective ways to promote sustainability related financing as in (Myronchuk et al., 2024), this study offers a framework for striking a balance between financial success and social and environmental responsibility by highlighting the necessity of employing thorough analysis and strategic planning to raise money for sustainable development, including green bonds and green investors.

2.3 Government role: policy, trust, and participation

As per (Wang et al., 2014), sustainability in a country's local setting includes not only environmental actions, like energy saving, but also political initiatives to integrate people, build the organizational capability, and promote wider acceptance. Governments and local administrators can play a significant role in sustainability leadership by involving citizens, boosting technical know-how, mobilizing financial resources, and building managerial sustainability execution capacity (Masuda et al., 2022). In order to improve the organizational performance of sustainability-related policies, effective administrators help overcome fragmented public perceptions, organizational limits, and technical problems in local sustainability. The results of research by (Saha, 2009) show that the state's role plays a significant effect in determining sustainability scores. The state's involvement in local sustainability planning initiatives has had an overwhelmingly beneficial impact, which implies that the state's growth management laws and planning requirements are important instruments for promoting sustainability laws. Therefore, Local governments are becoming more significant players in global climate policy (Broto et al., 2022). They have the ability to implement proper laws that promote sustainable growth. Therefore government involvement is the major driving force in imposing environmental-related policies that encourage sustainable development (ling Guo et al., 2017).

Numerous research studies, proposals, and actions aimed at achieving sustainability have emerged at both governmental and personal levels. In some cases, a "Carrot and Stick" approach has been employed. This approach seeks to incentivize sustainability practices, as studied by the authors in (Mahmoodi et al., 2018). Their research, conducted with a representative sample of Swiss energy consumers, revealed that consumers generally prefer electricity tariffs that reward lower power consumption over tariffs that penalize higher consumption. However, tariffs that combine both rewards and penalties have a noteworthy chance of gaining acceptance in the market. A similar investigation was carried out by (Giacomini et al., 2018) in Italy. They considered the "carrot" aspect sustainability related reporting aimed at promoting sustainable development. Their analysis indicated a decline in the use of such reports in recent years due to challenges including cost considerations, voluntariness, and the limited usefulness of sustainability reports. Most Italian municipalities have not initiated or sustained sustainability reporting over time. Ultimately, these studies did not significantly inspire individuals to adopt sustainable practices, and the "carrot" strategy proved ineffective. According to (Giacomini et al., 2018), implementing requirements that must be met may be more effective when employing a "stick" approach instead of relying solely on incentives. However, it's worth noting that the "carrot" policy did yield success in the investigation conducted by (Dahlmann et al., 2017). Their findings, based on a large dataset of multinational corporations, suggest that offering both monetary and non-monetary rewards and involving a broader range of beneficiaries at various organizational levels are generally more likely to result in reductions in a company's greenhouse gas emissions.

2.4 Climate-risk awareness and adoption intention

The behavior of society in any country can affect sustainable development as well (Dhahri et al., 2021). There are many driving forces that can encourage the deployment of Renewable Energy. Awareness of the problem by providing the public with information on climate change causes, consequences and mitigations is part of the solution (A et al., 2017). Many polls have been organized to assess how much the world is aware of global warming and the change in the climate. The people in developed countries such as Japan, European countries and America were progressively aware and worried about what is happening around the globe, and based on that they were very supportive of any measures including environmental-related policies and regulations that can be taken to deal with the global warming and climate change. A conclusion is made by (Wynes and Nicholas, 2018) that there is a chance to promote gas emissions reduction by improving education and communication structures.

Measuring the anxiety about climate change among the public can help also in deciding the effective measures to address climate change exacerbation (Hickman et al., 2021). Climate-related anxiety is not universal; unsurprisingly, individuals who care more about environmental issues are more likely to experience it. Therefore, fear of climate change consequences can also serve to acknowledge the problem so measures can be investigated to mitigate it. Climate catastrophe was selected as the word of the year 2007 by the German Language Society, which gives an indication of the increasing fear of climate change. In addition to terrorism, the word "fear" became strongly associated with environmental destruction by humans (Dörries, 2010).

Renewable Energy is a type of Energy which generates power without harmful gas emissions. But the cost of integrating Renewable Energy in residential and commercial buildings might

be a barrier to its integration. However, the financing of Renewable Energy projects as addressed by (Razali, 2019), (Mat Rahim and Mohamad, 2018) and (Soeleman and Lestari, 2015) was a reasonable attempt to push for the adoption of sustainable development projects.

Each country has its own perception of climate change so the place-based research demonstrates clearly that local ecology and culture have an impact on how people address climate change (Crona et al., 2013). As the Gulf Region is rich with sun brightness, where solar Renewable Energy can be widely used, it is a potential region to occupy an advanced position in the list of countries that will be employing such energy technologies. This study examines the general mood of people in the United Arab Emirates regarding the integration of sustainable development into their homes. Moreover, it will investigate the relative importance of some factors that predict the deployment of Renewable Energy in the UAE. This particular topic was not addressed yet in the UAE, therefore this work highlighted this gap and offered a quantitative analysis to bridge it and to find the factors that expedite the adoption of Renewable Energy in the UAE.

Based on the preceding literature review and outcomes, economic payoffs and price competitiveness are core levers; therefore, the study modelled the Economic Benefits and Competitive Financial Price as distinct predictors. It is also concluded that clear, trustworthy, easy-to-use policy increases uptake; thus, the Government Role was modelled as a predictor. In the same way The Climate-risk awareness showed mixed but positive links to intention for the adoption of renewable energy; therefore the Awareness & Fear was modelled as a predictor too.

The contribution anticipated from the research findings is to quantify and rank adoption motivators, including economic benefits, government role and climate risk awareness, addressing the actual research gap. Such data provide a level of granularity that is not typically reported in previous studies conducted in the UAE.

2.5 Theoretical framework

This study explains household Adoption of Renewable Energy through four literature-derived drivers: Economic Benefits (bill savings, payback), Competitive Financial Price (affordability vs. grid), Government Role (clarity of policy, incentives, administrative ease), and Awareness & Fear of Climate Change (risk salience, concern). The reviewed literature sections motivate these drivers (e.g., climate-risk salience; finance as barrier/enabler; the role of governmental incentives and rules) and justify testing them in the UAE's context. Accordingly, the framework defines Adoption of Renewable Energy as the dependent variable and theorises the four drivers as theory-based predictors to be empirically ranked and interpreted. This framing explicitly ties prior evidence to our model choices and sets up hypotheses H1–H5 that each driver is positively associated with adoption.

These constructs are operationalized with a structured survey and test the predicted relationships via factor analysis and regression to quantify the relative contributions of each driver in the UAE setting—i.e., using existing theory to interpret results and to assess theory performance in a new context.

Although this study measures perceptions at the household level, the proposed framework can be adjusted for different residential project scales. For small projects such as individual villas, the constructs mainly reflect the family's own investment decision, electricity bill savings and interaction with government procedures. For larger multi-residential buildings or compounds, the same constructs can be redefined at building or community level, for example, by considering shared PV systems, common-area energy costs, service charges and collective decision-making by owners' associations. This flexibility allows architects, engineers, planners and policymakers to apply the framework to a range of residential project types in the UAE.

2.6 Conceptual framework

The characteristics or attributes of the subjects that were examined in the research are referred to as research variables. A conceptual framework was developed to illustrate the relationships between these variables and to visually present how they are interconnected.

Existing literature highlights the significant influence of socio-economic status, housing ownership, and energy literacy on Renewable Energy adoption. Accordingly, this study considers socio-economic indicators—including income, education, and housing type—as independent variables, while the intention or willingness to adopt Renewable Energy solutions at home is treated as the dependent variable.

The literature review indicated also that the global socio-economic independent variable is attributed to many dimensions which are identified to be "Fear of Climate Change", "Awareness of Global Warming", "Financing Renewable Energy Projects" and "Government Role". As a result, the study model can be visualized in Figure 1, and specific hypotheses have been formulated for analysis - where variables were symbolized using boxes, and a directional arrow extending from the independent variable to the dependent variable that signified a causal connection -. The objective is to evaluate the validity of these hypotheses, which can be articulated as follows:

H1: A strong connection is hypothesized between "Socio-economical" independent global variable and "Adoption of Renewable Energy" dependent variable.

H2: A strong connection is hypothesized between the factor "Fear of Climate Change" and "Adoption of Renewable Energy" dependent variable.

H3: A strong connection is hypothesized between the factor "Awareness of Global Warming" and "Adoption of Renewable Energy" dependent variable.

H4: A strong connection is hypothesized between the factor "Financing Renewable Energy Projects" and "Adoption of Renewable Energy" dependent variable.

H5: A strong connection is hypothesized between the factor "Government Role" and "Adoption of Renewable Energy" dependent variable.

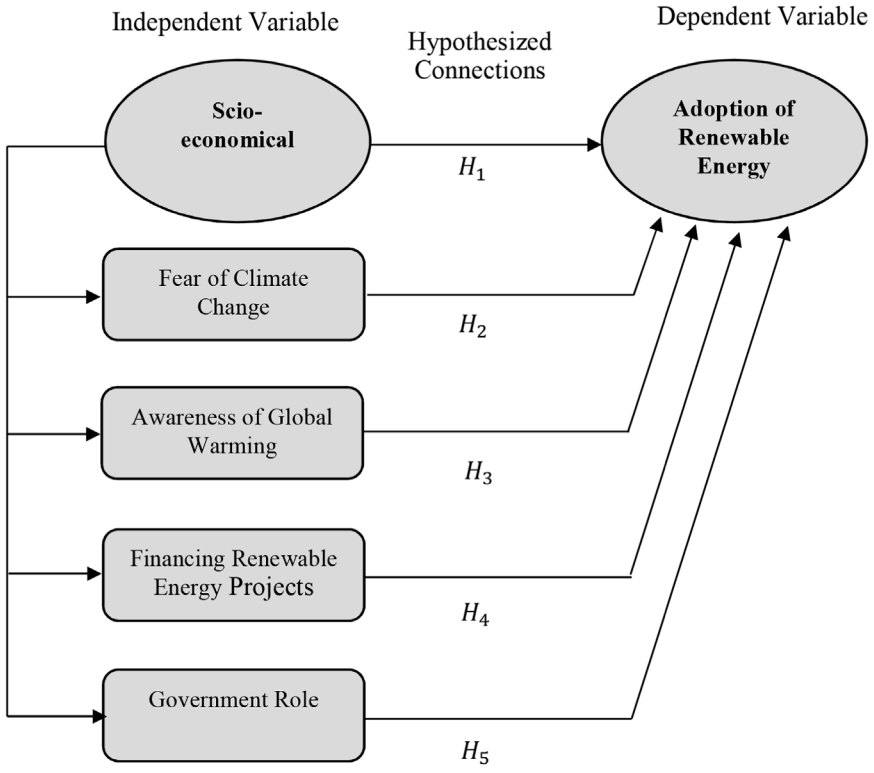

FIGURE 1
Model of study.

3 Research methodology

The authors in this study employ a quantitative, cross-sectional survey methodology as the study examines theory-driven hypotheses that connect latent drivers such as Awareness & Fear, Competitive Financial Price, Economic Benefits, and Government Role to households' adoption intentions. This requires standardized measurement, reliability and dimensionality checks (Cronbach's alpha), and estimation of effect sizes via regression, enabling generalizable ranking of predictors across UAE household segments. A structured questionnaire efficiently captures attitudes and socio-demographics at scale and aligns with the theoretical framework and hypotheses (H1–H5) specified for model testing.

This study employs a quantitative research methodology to investigate the motivating factors driving the adoption of Renewable Energy among residents in the United Arab Emirates (UAE). The research specifically examines household-level decisions regarding Renewable Energy integration, recognizing the housing sector as a critical domain for reducing carbon emissions and promoting sustainability. Residential buildings are among the highest consumers of electricity in the UAE, largely due to air conditioning and lighting needs—making them a strategic entry point for Renewable Energy adoption (Akhozheya et al., 2018).

A structured questionnaire was used to collect primary data from a diverse sample of individuals in both the public and private sectors across various emirates. Adult residents of the United Arab Emirates living in villas or apartments were targeted using a non-probability convenience sampling strategy. Potential participants were approached through community groups and university networks and invited to complete a self-administered questionnaire. Participation was voluntary and anonymous, and respondents provided informed consent before starting the survey. The sample was selected to represent different housing types, ownership models (owners vs. renters), and income brackets to reflect the heterogeneity of UAE households. The questionnaire included targeted questions exploring attitudes, awareness, perceived economic benefits, and policy perceptions related to Renewable Energy use within homes (villas and apartments).

3.1 Ethical consideration

This study received prior approval from the Institutional Ethics Committee of The British University in Dubai. Before starting the questionnaire, participants read an information sheet and provided informed consent; participation was voluntary, and they could skip any question or withdraw at any time. No names or direct identifiers were collected; data were recorded and analyzed anonymously, stored on a password-protected drive accessible only to the research team. The study posed minimal risk and complied with institutional and international human-subjects guidelines.

TABLE 1 Exploratory factor analysis of survey items on key drivers of residential renewable energy adoption in the UAE.

Rotated Component Matrix[a]				
	Component			
	1	2	3	4
Worries 1	.541			
Worries 2	.700			
Worries 3	.624			
Worries 4	.782			
Awareness 1	.634			
Awareness 2	.628			
Awareness 3			.543	
Awareness 4	.547			
Awareness 5			.592	
Economical 1				.721
Economical 2			.690	
Economical 3			.713	
Economical 4				.464
Economical 5				.511
Gov. Role 1		.492		
Gov. Role 2		.580		
Gov. Role 3		.549		
Gov. Role 4		.877		
Gov. Role 5		.863		

Extraction Method: Principal Component Analysis
Rotation Method: Varimax with Kaiser Normalization.
[a]Rotation converged in 8 iterations

Furthermore, a reliability test has been conducted on the items related to the dependent factor, "Adoption of Renewable Energy." The Cronbach's Alpha reliability test was employed, and the result indicates a high level of reliability, surpassing the reference threshold of 0.6, as shown in Table 2.

TABLE 2 Cronbach's Alpha test.

Reliability statistics	
Cronbach's alpha	N of items
0.740	5

3.2 Sample of the study

Based on the confidence level of 95%m margin error of 5% and population portion of 95%, the sample size has been calculated as 73, however, the questionnaire has been distributed to 90 people and only 82 of the 90 copies were given out to the representatives owners of houses of the chosen sectors were validated. The questionnaire's items explain four independent factors as well as one global dependent variable that has only one dimension: "Adoption of Renewable Energy in UAE." Likert's five-point scale was used to evaluate the responses to the questions, with one representing strongly disagree and 5 representing strongly agree.

3.3 Factor analysis

The initial step in data analysis involves evaluating the reliability of questions in representing and measuring specific factors. Questions that demonstrate weak reliability are excluded from further consideration. The remaining questions can then be used for either correlation or regression tests.

Table 1 presents the results of the factor analysis test conducted on 19 items, along with their categorization under specific factors. It's evident that items originally associated with different factors have been grouped together under a single component. Consequently, these factors can be merged, giving rise to new ones. Within Component 1, a new factor labelled "Awareness and Fear of Global Warming" can be formulated. Another new factor is composed of select items from Component 2, designated as "Competitive Financial Price." The third new factor is called the "Economic Benefits" of renewable energy. However, the final factor retains its original label of "Government Role" concerning Renewable Energy. As a result, the revised hypotheses can be reformulated as follows:

H1: A strong connection is hypothesized between "Socio-economical" independent global variable and "Adoption of Renewable Energy" dependent variable.

H2: A strong connection is hypothesized between the factor "Fear of Climate Change" and "Adoption of Renewable Energy" dependent variable.

H3: A strong connection is hypothesized between the factor "Awareness of Global Warming" and "Adoption of Renewable Energy" dependent variable.

H4: A strong connection is hypothesized between the factor "Financing Renewable Energy Projects" and "Adoption of Renewable Energy" dependent variable.

H5: A strong connection is hypothesized between the factor "Government Role" and "Adoption of Renewable Energy" dependent variable.

Table 1 summarizes the rotated factor loadings and explained variance for the constructs used later in the regression model.

4 Results and discussions

The survey yielded 82 valid responses from residents living in villas and apartments across the UAE. Overall, the responses show that many participants express concern about climate change and generally favorable attitudes toward renewable energy, but their stated intention to install residential systems remains at a moderate

TABLE 3 Regressions analysis between fear and awareness of global warming and adoption of renewable energy.

Model summary				
Model	R	R square	Adjusted R square	Std. Error of the estimate
1	0.274[a]	.075	.064	2.87394

ANOVA[b]					
Model	Sum of squares	df	Mean square	F	Sig
1 Regression	53.736	1	53.736	6.506	.013[a]
Residual	660.764	80	8.260		
Total	714.500	81			

[a]Predictors: (Constant), fear. awareness. new.
[b]Dependent variable: RE, employment.

TABLE 4 Regressions analysis between Economic Benefits and Adoption of Renewable Energy.

Model summary				
Model	R	R square	Adjusted R square	Std. Error of the estimate
1	0.652[a]	.425	.418	2.26655

ANOVA[b]					
Model	Sum of squares	df	Mean square	F	Sig
1 Regression	303.520	1	303.520	59.082	0.000[a]
Residual	410.980	80	5.137		
Total	714.500	81			

[a]Predictors: (Constant), Economical. benefits.
[b]Dependent variable: RE, employment.

level. Perceptions of economic benefits and competitive financial price tend to be more positive than views about the clarity and accessibility of government procedures and incentives, indicating that both financial considerations and institutional factors shape households' willingness to adopt renewable energy technologies.

These descriptive outcomes provide the context for the multivariate analysis that follows, which examines how the main drivers (i.e., Fear and Awareness of Global Warming, Competitive Financial Price, Economic Benefits, and Government Role) jointly influence adoption intention.

After verifying the reliability of the questions related to the questionnaire items, a regression analysis may be conducted to authenticate and validate the study hypotheses. The regression test is conducted via the SPSS software in order to judge the validity of the hypotheses developed in the study based on which Tables 3–6 are generated.

4.1 Research findings

Reading the statistical results in Table 3 gives information about the significance of the relationship between the "Fear and Awareness of Global Warming" and the "Adoption of Renewable Energy" in the UAE, with "F" value equal to 6.506. It can be seen from the Table 3 that there is a high significance in the relationship between the two variables, with a value of p = 0.013. In the meanwhile, "adjusted R square" value is (0.064) so it can be interpreted as there is statistical evidence with a chance of 6.4% that the adoption of Renewable Energy in UAE is shaped by people's fear and awareness of global warming. Consequently, Table 3 shows that the Fear and Awareness of Global Warming factor has a positive and statistically significant effect on the intention to adopt renewable energy at home, indicating that respondents who are more worried about climate change are more willing to consider installing such systems. Therefore, hypothesis H1 is valid and established. The positive yet modest effect of Fear and Awareness of Global Warming (Adj. R^2 = 0.064) is consistent with prior evidence that climate-risk awareness is a necessary but not sufficient condition for behavioural change. Studies on social behaviour and sustainable development highlight that societal values, perceptions of risk and behavioural entrepreneurship can stimulate low-carbon practices, but typically in interaction with other structural drivers (Dhahri et al., 2021). Public information and education campaigns about climate change causes, consequences and mitigation options have been shown to increase support for emissions-reduction policies and pro-environmental choices (A et al., 2017; Wynes and Nicholas, 2018). At the same time, research on climate anxiety and "climate catastrophes" shows that fear can sharpen concern and recognition of the problem but does not automatically translate into concrete action in the absence

TABLE 5 Regressions analysis between Economic Benefits and Adoption of Renewable Energy.

Model summary				
Model	R	R square	Adjusted R square	Std. Error of the estimate
1	0.424[a]	.180	.170	2.70644

ANOVA[b]					
Model	Sum of squares	df	Mean square	F	Sig
1 Regression	128.516	1	128.516	17.545	.000[a]
Residual	585.984	80	7.325		
Total	714.500	81			

[a]Predictors: (Constant), competitive. finan. price.
[b]Dependent variable: RE, employment.

TABLE 6 Regressions analysis between Government Role and Adoption of Renewable Energy.

Model summary				
Model	R	R square	Adjusted R square	Std. Error of the estimate
1	0.427[a]	.182	.172	2.71910

ANOVA[b]					
Model	Sum of squares	df	Mean square	F	Sig
1 Regression	130.160	1	130.160	17.605	0.000[a]
Residual	584.087	79	7.394		
Total	714.247	80			

[a]Predictors: (Constant), gov. role. new.
[b]Dependent variable: RE, employment.

of enabling conditions (Hickman et al., 2021; Dörries, 2010). Place-based studies further indicate that local ecological and cultural contexts shape how communities interpret climate risks and incorporate them into everyday decisions (Crona et al., 2013). In this light, the present finding suggests that in the UAE context, climate-risk communication and awareness campaigns can meaningfully contribute to household renewable-energy adoption, but their impact will be limited unless they are complemented by financial and policy levers that address cost and implementation barriers.

Similarly, Table 4, gives statistical information about the second hypothesis and information about the relationship between "Competitive Financial Price" and "Adoption of Renewable Energy" with "F" value equal to 17.545, so that there is a high significance in the relationship between the two variables with $p < 0.001$, "adjusted R square" value is (0.170), which indicates there is statistical evidence of 17% chance that Adoption of Renewable Energy in UAE is predicted by the "Competitive Financial Price" factor. This means that the Competitive Financial Price factor has a clear positive and statistically significant effect on the intention to adopt renewable energy at home: respondents who perceive installation costs, electricity tariffs and payback periods as more competitive report higher intention scores. The analysis indicates that Competitive Financial Price alone explains about 17% of the variance in adoption intention, highlighting the central role of perceived affordability in shaping household decisions about rooftop solar and other residential renewable options in the UAE. Therefore, hypothesis H2 is valid and established.

The finding that Competitive Financial Price explains 17% of the variance in adoption intention underscores the central role of affordability and price competitiveness in household energy decisions. The literature on sustainability economics stresses that households and firms often perceive environmental investments as cost burdens unless they see clear financial advantages or cost neutrality (Ekins and Zenghelis, 2021; Song et al., 2017). When renewable options are priced competitively relative to conventional grid electricity, perceived financial risk declines and adoption becomes more attractive, particularly for middle-income households with constrained budgets (Ye and Dela, 2023; Jeucken, 2010). Macro-level analyses also show that global financial flows and appropriate pricing instruments are critical for scaling renewable deployment; modest changes in financial architecture or fiscal instruments can unlock substantial investment in Renewable Energy (Carnicer and Peñuelas, 2012; Schwerhoff and Sy, 2017). At the project level, innovative green financing tools such as green bonds and dedicated sustainable-development instruments have been proposed to bridge the cost gap for low-carbon technologies (Myronchuk et al., 2024; Razali, 2019; Mat Rahim and Mohamad, 2018; Soeleman and Lestari, 2015). In the context of UAE households, the present result confirms that policy instruments which improve the relative price of rooftop solar and other

renewable technologies (e.g., time-of-use tariffs, preferential loans, or green sukuk-backed offers) are likely to yield tangible gains in adoption, complementing broader awareness and policy initiatives.

Table 5 shows, in the same way, the relationship between "Economical Benefits" with "Adoption of Renewable Energy", the "F" value is 50.082, so there is a high significance of the relationship between the two variables with $p < 0.001$, "adjusted R square" value is (0.418), which means there is statistical evidence of 41.8% that Adoption of Renewable Energy in UAE is shaped by the "Economical Benefits". These statistical data indicate that the Economic Benefits factor is the strongest predictor among the four drivers, with a positive and statistically significant effect on adoption intention. Households that expect clear long-term financial gains—such as lower monthly electricity bills and improved property value—are substantially more willing to consider installing renewable energy systems. Economic Benefits account for about 41.8% of the explained variance in adoption intention, confirming that perceived long-term savings are the primary motivator for accelerating residential renewable -energy uptake in the country. Therefore, hypothesis H3 is valid and established.

The result that Economic Benefits account for 41.8% of the explained variance and emerge as the strongest predictor confirms that perceived bill savings and financial gains are the dominant motivators for household renewable-energy adoption in the UAE. This aligns with prior work showing that when environmental measures also deliver tangible economic value—through lower operating costs, productivity gains or enhanced asset value—actors are far more likely to support and invest in sustainable options (Ekins and Zenghelis, 2021). Empirical studies of firms indicate that environmental management is embraced when it is associated with improved financial performance rather than purely additional costs (Song et al., 2017; Adewole, 2024). In the built-environment literature, economic benefits are repeatedly identified as a primary driver for green construction and energy-efficient retrofits, particularly where savings on energy bills and life-cycle costs can be quantified and communicated to decision-makers (Rheude et al., 2021, Akhozheya et al., 2018). The present findings extend this logic to UAE households: residents appear willing to adopt renewable technologies when they can clearly see reductions in electricity bills and improvements in long-term affordability. This suggests that emphasising concrete economic paybacks—through tools like bill simulators, case studies of successful households, and transparent payback calculations—may be one of the most effective strategies for accelerating residential renewable -energy uptake in the country.

To decide on the impact of the government's role in predicting the adoption of Renewable Energy in UAE, Table 6 shows the related statistics figures, the "F" value is equal to 17.605, so there is a high significance of the relationship between the two variables with $p < 0.001$, "adjusted R square" value is (0.172), which means there is statistical evidence of 17.2% that adoption of Renewable Energy by the people in the UAE is shaped by the "Government role". The table shows that the Government Role factor also exerts a positive and statistically significant effect on intention to adopt, although its impact is more modest than that of direct economic considerations. Respondents who perceive government policies, procedures and incentives as clear, trustworthy and supportive are more inclined to install renewable energy technologies at home. Government Role explains about 17.2% of the variance in adoption intention, indicating that transparent, accessible and well-communicated policy frameworks are necessary to sustain and expand household participation in the energy transition. Therefore, hypothesis H4 becomes valid and established. The finding that Government Role explains 17.2% of the variance in adoption intention reinforces the literature that positions governments especially local and national authorities as key enablers of sustainability transitions. Research on sustainability leadership in local government shows that administrative capacity, citizen engagement and policy coherence can overcome fragmented public perceptions and technical barriers, thereby improving implementation of sustainability measures (Wang et al., 2014; Masuda et al., 2022). Studies of local and state governments further demonstrate that regulatory frameworks, planning laws and growth management instruments can significantly influence sustainability performance and climate policy outcomes (Saha, 2009; Broto et al., 2022). From a broader environmental regulation perspective, effective government intervention and innovation-oriented policies are associated with improved regional green growth performance (ling Guo et al., 2017). Within the UAE, national initiatives such as the Net Zero by 2050 Strategic Initiative, large-scale solar investments and the country's role as host of COP28 signal a strong top-down commitment to Renewable Energy and climate action (Alkhaldi et al., 2023; Maniruzzaman and Al-Saleem, 2025; Climate Neutrality a National Priority, 2025; News And Media, 2025). The present result suggests that households respond to this institutional context: clear, trustworthy, and easy-to-use policies—including incentives, streamlined procedures and supportive regulations—are perceived as meaningful drivers of adoption. This underscores the importance of maintaining policy stability, enhancing administrative simplicity and communicating incentives transparently to sustain and expand household participation in the energy transition.

Taken together, the four drivers—Economic Benefits, Government Role, Competitive Financial Price, and Fear/Awareness of Global Warming—explain approximately 82.4% of the variance in renewable-energy adoption intention, offering a rare, quantified ranking of household-level motivators in the UAE. This multi-factor structure mirrors broader sustainability frameworks which emphasize that progress depends on the combined influence of economic incentives, governance arrangements and socio-psychological change rather than any single dimension alone (ElAlfy et al., 2020, Brizga et al., 2014). Behaviour-centred work on sustainable development similarly stresses that entrepreneurial behaviour, social norms and perceived opportunities interact with institutional and financial contexts to shape actual adoption of green practices (Dhahri et al., 2021). In the housing and energy domain, prior studies show that while climate-risk awareness and environmental concern legitimise sustainability agendas, households typically require supportive policy signals and favourable financial conditions before translating concern into investment decisions (Desvallées, 2022; Baek and Park, 2012; Adewole, 2024). The present study empirically confirms this layered picture for UAE homes: economic payoffs emerge as the primary lever, policy and pricing form a strong secondary layer, and climate-risk awareness provides an important but comparatively weaker underpinning. This integrated pattern has

practical implications for policy design, suggesting that the most effective programmes will be those that align clear economic benefits and competitive pricing with stable, trusted government frameworks and sustained climate-education efforts.

4.2 Assessing the role of this study in advancing renewable energy research

The transition to Renewable Energy in the Gulf Cooperation Council (GCC) countries, particularly the UAE, has been explored through various disciplinary lenses. However, this study—"Shaping Sustainable Futures: A Study of Renewable Energy Sentiments in the UAE"—fills a notable gap in the literature by directly assessing the psychological and socio-economic motivations behind Renewable Energy adoption through quantitative sentiment analysis. A comparison with four recent and relevant studies underscores this contribution:

4.2.1 Focus on public motivation vs. technological and policy-oriented frameworks

The study by (Alshehh et al., 2024) focused on the adoption of wind energy using a systematic review and modelling approach. It emphasized technological innovation, grid integration, and environmental impact as core variables for successful adoption, with results validated through SEM and MLR analysis. While it thoroughly assessed structural factors, it lacked direct analysis of public sentiment toward Renewable Energy adoption, especially across mixed sources (solar, wind, grid). On the other hand, this study bridges this gap by identifying psychological and financial motivations from an individual-level perspective in the UAE. Beside that this study adds value by showing that economic benefits (41.8%) and government role (17.2%) are top motivators, highlighting how socio-psychological drivers complement technological and policy enablers.

4.2.2 Beyond regional policy narratives into community sentiment

The research in Jamaledini and Bayat (2024) explored macro-scale Renewable Energy transitions in the Gulf—highlighting national policies, economic diversification, and Vision 2030 strategies. Their work offers a top-down perspective on sustainable development. However, it does not address the citizen-level acceptance or the motivational weight of Renewable Energy benefits on behavior. While this research responds to this gap with a bottom-up lens, evaluating Renewable Energy sentiment through measurable public opinion, providing policymakers with micro-level data that complements national strategies.

4.2.3 Focus on nuclear vs. broader renewable sentiment

The research in (Baqi et al., 2023) assessed how direct stakeholder engagement influences public trust in nuclear energy sustainability in the UAE. Their study confirmed that trust and perception of safety can be enhanced by inclusive communication. While this is important, it remains sector-specific (nuclear) and does not explore financial or motivational factors influencing general Renewable Energy adoption. On the other hand, this study adds breadth by evaluating a broader spectrum of renewable energies, providing a more comprehensive view of motivators beyond perception—such as financial incentives and government trust—that extend across solar, wind, and other Renewable Energy sources.

4.2.4 Technical gaps vs. social-economic readiness

The research in (Alhammadi, 2024) focused on energy storage technologies (EST) and their integration into the UAE's energy mix. This doctoral research offered insights into policy gaps, grid reliability, and technological limitations, especially under harsh UAE climates. While (Alhammadi, 2024) research was rich in technical insights, it lacked assessment of public readiness to accept or support the deployment of these technologies. On the other hand, this study complements this by capturing public sentiment, a key missing piece in technological adoption. While EST is vital, community support rooted in perceived economic advantages and awareness plays an equally vital role in ensuring adoption and long-term integration.

Thus, this research is uniquely positioned in the UAE's Renewable Energy discourse because:

- It directly quantifies public sentiment on motives for Renewable Energy adoption, rather than relying solely on expert views or technological capabilities.
- It identifies economic benefit as the leading motivator—an insight critical for designing public campaigns, subsidies, or financial incentives.
- It reinforces the role of government trust, a key issue not always addressed in technology-centered studies.
- It uncovers the lower weight of global warming awareness (6.4%), suggesting a need to strengthen environmental education efforts in parallel with financial strategies.
- It opens pathways for future studies to explore psychographic and behavioral drivers of energy transition—a field currently underdeveloped in the UAE and broader Gulf region.

5 Conclusion

There is a common understanding around the globe that global warming is the most challenge in the 21st century. It is important to promote a transition in people's social-psychological mindsets toward less materialistic values and lifestyles. The literature identified several factors that motivate nations to pursue sustainable development. Fear and awareness of global warming, financing of sustainable development projects and the government's role are among the main factors that encourage communities to adopt renewable energy. Such adoption can contribute to the international efforts to support the mitigation of climate change.

This study has employed a quantitative research methodology to assess the sentiment of people in the UAE toward the adoption of Renewable Energy. A representative sample of UAE residents from various sectors was surveyed through a structured questionnaire. The findings confirm important insights into the prospects of Renewable Energy deployment in the UAE. It shows that the most influential driver for Renewable Energy adoption is "Economic Benefits," carrying the greatest weight at 41.8%. The next strongest motivators are "Competitive Financial Price" and "Government

Role," each contributing approximately 17% to the decision-making process. Awareness and concern about global warming also play a role, though to a lesser extent, with a 6.4% influence. These four factors together represent a cumulative influence of 82.4%. Based on these findings, several design solutions and housing typologies can guide architects, engineers, urban planners, and policymakers. New villas should be designed with south- and west-oriented, minimally shaded roofs; integrated cable routes and inverter locations; and structural allowances for rooftop solar PV. This reduces installation cost and complexity, directly supporting the strong role of economic benefits and competitive financial price identified in this study.

Medium- and high-rise residential buildings can adopt a "shared solar roof" typology, where a single PV system serves multiple apartments through building-level metering and fair cost-sharing schemes. This responds to the government role and policy incentives factor by making collective adoption technically and administratively straightforward. In existing neighbourhoods with limited roof space, planners can prioritise solar carports and shaded walkways as standard elements in streetscape and parking design. These solutions improve outdoor comfort while generating electricity, making the economic and environmental co-benefits more visible to residents. Public and affordable housing projects can be specified as "net-zero-ready," with mandatory high-efficiency envelopes, pre-installed conduits for PV, and provisions for future battery integration. This aligns with the Net Zero by 2050 agenda and demonstrates to residents that renewable energy is feasible and financially attractive. To strengthen the government role factor, authorities can publish standardised design templates, checklists and timelines for rooftop PV and shared systems, reducing perceived bureaucratic risk and uncertainty. Together, these design-oriented recommendations translate the statistical drivers identified in this research into concrete guidelines that can be directly applied by design professionals and policymakers to accelerate residential renewable energy adoption in the UAE.

Notably, the residential sector emerges as a critical domain for implementing Renewable Energy transitions. Households are both key energy consumers and potential adopters of rooftop solar panels, energy-efficient systems, and other renewable technologies. Therefore, understanding residents' motivations, barriers, and energy behaviors at the household level is essential to scaling national efforts.

This study provides valuable insights into how housing-focused strategies—including tailored incentives, awareness campaigns, and green building codes—can amplify the uptake of Renewable Energy across UAE communities.

Finally, this study offers useful empirical evidence to the practitioners, expert community and the local authority in the UAE about the most effective factors that might expedite the adoption of Renewable Energy in the country.

6 Limitations

While this study provides valuable insights, it also has certain limitations. The reliance on a questionnaire-based quantitative approach may limit the ability to explore deeper, more nuanced aspects of individual decision-making processes. Future studies could address this by incorporating qualitative techniques such as interviews or focus groups to enrich the findings. Additionally, there may be influential factors affecting Renewable Energy adoption in the UAE that were not captured in this research or highlighted in the existing literature. Future research is encouraged to adopt mixed-method approaches and focus more closely on specific residential contexts to uncover these additional dimensions and offer a more holistic understanding of Renewable Energy uptake.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent from the [patients/participants OR patients/participants legal guardian/next of kin] was not required to participate in this study in accordance with the national legislation and the institutional requirements.

Author contributions

MS: Conceptualization, Formal Analysis, Methodology, Resources, Visualization, Writing – original draft, Writing – review and editing. BT: Data curation, Investigation, Project administration, Software, Supervision, Validation, Writing – original draft, Writing – review and editing.

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Conflict of interest

The author(s) declared that this work was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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References

Abuelgasim, A., and Daiban, S. (2017). Levels of climate change awareness in the United Arab Emirates. *Horizons Humanit. Soc. Sci. An Int. Refereed J.* 2 (2). doi:10.19089/hhss.v2i2.61

Abbass, K., Qasim, M. Z., Song, H., Murshed, M., Mahmood, H., and Younis, I. (2022). "A review of the global climate change impacts, adaptation, and sustainable mitigation measures," in *Deutschland GmbH*. Springer Science and Business Media. doi:10.1007/s11356-022-19718-6

Adewole, O. (2024). The need for social equality from emerging patterns in business and costs towards environmental sustainability in a new paradigm shift. *Int. J. Corp. Soc. Responsib.* 9 (1), 15. doi:10.1186/s40991-024-00100-3

Akhozheya, B., Syam, M., Abdelghani, R., and Aoul, K. A. T. (2018). Retrofit evaluation of a residential building in UAE: energy efficiency and renewable energy. *2018 5th Int. Conf. Renew. Energy Generation Appl. (ICREGA)*, 238–242. doi:10.1109/ICREGA.2018.8337615

Alhammadi, K. A. (2024). Analysis of energy storage technologies in the United Arab Emirates: current state and future needs.

Alkhaldi, M., Moonesar, I. A., Issa, S. T., Ghach, W., Okasha, A., Albada, M., et al. (2023). Analysis of the United Arab Emirates' contribution to the sustainable development goals with a focus on global health and climate change. *Int. J. Health Gov.* 28 (4), 357–367. doi:10.1108/IJHG-04-2023-0040

Alshehhi, M., Alkhalidi, A., and Dweiri, F. (2024). Investigating factors influencing the adoption and sustainable development of wind energy in the UAE. *Int. J. Thermofluids* 22, 100680. doi:10.1016/J.IJFT.2024.100680

Baek, C. H., and Park, S. H. (2012). Changes in renovation policies in the era of sustainability. *Energy Build.* 47, 485–496. doi:10.1016/j.enbuild.2011.12.028

Baqi, A., Abdeldayem, M., and Aldulaimi, S. (2023). Assessing the role of direct public engagement in shaping the UAE nuclear energy sustainability image. *Int. J. Organ. Analysis* 32, 1669–1688. doi:10.1108/IJOA-05-2023-3776

Brizga, J., Mishchuk, Z., and Golubovska-Onisimova, A. (2014). Sustainable consumption and production governance in countries in transition. *J. Clean. Prod.* 63, 45–53. doi:10.1016/j.jclepro.2013.06.011

Broto, V. C., Westman, L., and Campillo, X. R. (2022). The role of local governments in international climate policy. *Oxf. Res. Encycl. Clim. Sci.* doi:10.1093/ACREFORE/9780190228620.013.842

Burt, J. A. (2023). *A natural history of the emirates*. Cham, Switzerland: Springer Nature Switzerland.

Carnicer, J., and Peñuelas, J. (2012). The world at a crossroads: financial scenarios for sustainability. *Energy Policy* 48, 611–617. doi:10.1016/J.ENPOL.2012.05.065

Climate Neutrality a National Priority (2025). Climate neutrality a national priority, as UAE net zero 2050. Available online at: https://moccae.gov.ae/en/media-center/news/16/11/2023/climate-neutrality-a-national-priority-as-uae-net-zero-2050-strategy-accelerated-following-the-annou?utm_source=chatgpt.com (Accessed November 13, 2025).

Crona, B., Wutich, A., Brewis, A., and Gartin, M. (2013). Perceptions of climate change: linking local and global perceptions through a cultural knowledge approach. *Clim. Change* 119 (2), 519–531. doi:10.1007/S10584-013-0708-5/METRICS

Dahlmann, F., Branicki, L., and Brammer, S. (2017). Carrots for corporate sustainability': impacts of incentive inclusiveness and variety on environmental performance. *Bus. Strategy Environ.* 26 (8), 1110–1131. doi:10.1002/BSE.1971

Desvallées, L. (2022). Low-carbon retrofits in social housing: energy efficiency, multidimensional energy poverty, and domestic comfort strategies in southern Europe. *Energy Res. Soc. Sci.* 85, 102413. doi:10.1016/J.ERSS.2021.102413

Dhahri, S., Slimani, S., and Omri, A. (2021). Behavioral entrepreneurship for achieving the sustainable development goals. *Technol. Forecast Soc. Change* 165, 120561. doi:10.1016/J.TECHFORE.2020.120561

Dhillon, R. S., and von Wuehlisch, G. (2013). Mitigation of global warming through renewable biomass. *Biomass Bioenergy* 48, 75–89. doi:10.1016/j.biombioe.2012.11.005

Dörries, M. (2010). Climate catastrophes and fear. *Wiley Interdiscip. Rev. Clim. Change* 1 (6), 885–890. doi:10.1002/WCC.79

Dubai's Mohammed Bin Rashid Al Maktoum' 5,000MW solar Park aims to save 6.5 million tCO2e annually - C40 cities (2025). Available online at: https://www.c40.org/case-studies/dubai-s-mohammed-bin-rashid-al-maktoum-5-000mw-solar-park-aims-to-save-6-5-million-tco2e-annually/?utm_source=chatgpt.com (Accessed November 13, 2025).

Ekins, P., and Zenghelis, D. (2021). The costs and benefits of environmental sustainability. *Sustain Sci.* 16 (3), 949–965. doi:10.1007/s11625-021-00910-5

ElAlfy, A., Palaschuk, N., El-Bassiouny, D., Wilson, J., and Weber, O. (2020). Scoping the evolution of corporate social responsibility (CSR) research in the sustainable development goals (SDGs) era. *Sustainability* 12 (14), 5544. doi:10.3390/SU12145544

Future Economy. (2025). Future Economy | Ministry of Economy & Tourism - UAE. Available online at: https://www.moet.gov.ae/en/future-economy?utm_source=chatgpt.com (Accessed November 13, 2025).

Giacomini, D., Rocca, L., Carini, C., and Mazzoleni, M. (2018). Overcoming the barriers to the diffusion of sustainability reporting in Italian LGOs: better stick or carrot? *Sustainability* 10 (1), 131–2018. doi:10.3390/SU10010131

How can an individual contribute (2023). How can an individual contribute to sustainable development goals? Check Answer at BYJU'S.

Hickman, C., Marks, E., Pihkala, P., Clayton, S., Lewandowski, R. E., Mayall, E. E., et al. (2021). Climate anxiety in children and young people and their beliefs about government responses to climate change: a global survey. *Lancet Planet. Health* 5, e863–e873. doi:10.1016/s2542-5196(21)00278-3

IEA (2025). IEA – international energy agency - IEA. Available online at: https://www.iea.org/reports/energy-technology-perspectives-2022 (Accessed November 12, 2025).

Jamaledini, A., and Bayat, A. (2024). Examining the utilization of clean energies for sustainable development: a case study of Saudi Arabia, United Arab Emirates, and Qatar (MPRA Paper No. 123077). *Munich Personal RePEc Archive*. Available online at: https://mpra.ub.uni-muenchen.de/123077/.

Jeucken, M. (2010). "Sustainable finance and banking: the financial sector and the future of the planet," in *Sustainable finance and banking: the financial sector and the future of the planet*, 1–318. doi:10.4324/9781849776264

Khondaker, A. N., Hasan, M. A., Rahman, S. M., Malik, K., Shafiullah, M., and Muhyedeen, M. A. (2016). Greenhouse gas emissions from energy sector in the United Arab Emirates – an overview. *Renew. Sustain. Energy Rev.* 59, 1317–1325. doi:10.1016/J.RSER.2016.01.027

ling Guo, L., Qu, Y., and Tseng, M. L. (2017). The interaction effects of environmental regulation and technological innovation on regional green growth performance. *J. Clean. Prod.* 162, 894–902. doi:10.1016/j.jclepro.2017.05.210

Mahmoodi, J., Prasanna, A., Hille, S., Patel, M. K., and Brosch, T. (2018). Combining 'carrot and stick' to incentivize sustainability in households. *Energy Policy* 123, 31–40. doi:10.1016/J.ENPOL.2018.08.037

Maniruzzaman, A. F. M., and Al-Saleem, K. (2025). Renewable energy and energy justice in the Middle East: international human rights, environmental and climate change law and policy perspectives. *J. World Energy Law Bus.* 18 (1), jwae021. doi:10.1093/jwelb/jwae021

Masuda, H., Kawakubo, S., Okitasari, M., and Morita, K. (2022). Exploring the role of local governments as intermediaries to facilitate partnerships for the sustainable Development Goals. *Sustain Cities Soc.* 82 (Jul), 103883. doi:10.1016/j.scs.2022.103883

Mat Rahim, S. R., and Mohamad, Z. Z. (2018). Green sukuk for financing renewable energy projects. *Turkish J. Islamic Econ.* 5 (2), 129–144. doi:10.26414/M031

Myronchuk, V., Yatsenko, O., Riznyk, D., Hurina, O., and Frolov, A. (2024). Financing sustainable development: analysis of modern approaches and practices in the context of financial and credit activities. *Int. J. Econ. Financial Issues* 14 (5), 317–329. doi:10.32479/ijefi.16619

News and media (2025). News and media - COP28 UAE. Available online at: https://www.cop28.com/en/news-and-media?utm_source=chatgpt.com (Accessed November 13, 2025).

Obaideen, K., Nooman AlMallahi, M., Alami, A. H., Ramadan, M., Abdelkareem, M. A., Shehata, N., et al. (2021). On the contribution of solar energy to sustainable developments goals: case study on mohammed bin rashid Al maktoum solar park. *Int. J. Thermofluids* 12, 100123. doi:10.1016/J.IJFT.2021.100123

Olga, A. (2018). Sustainable development and its challenges in developing countries. Available online at: https://www.iynf.org/2018/08/a-guide-to-sustainable-development-and-its-challenges-in-developing-countries/.

Razali, F. I. (2019). Green sukuk financing for government Investment Issue (GII) in Malaysia. *J. Mech. Continua Math. Sci.* spl1 (4). doi:10.26782/JMCMS.SPL.4/2019.11.00001

Rheude, F., Kondrasch, J., Röder, H., and Fröhling, M. (2021). Review of the terminology in the sustainable building sector. *J. Clean. Prod.* 286, 125445. doi:10.1016/J.JCLEPRO.2020.125445

Saha, D. (2009). *Factors influencing local government sustainability efforts*, 41. Thousand Oaks, CA, United States: SAGE Publications.

Savaresi, A. (2016). The paris agreement: a new beginning? *J. Energy Nat. Resour. Law* 34 (1), 16–26. doi:10.1080/02646811.2016.1133983

Save nearly 30 per cent (2025). Save nearly 30 per cent of your electricity bill with right habits. Available online at: https://gulfnews.com/uae/save-nearly-30-per-cent-of-your-electricity-bill-with-right-habits-1.492637?utm_source=chatgpt.com (Accessed November 13, 2025).

Schwerhoff, G., and Sy, M. (2017). Financing renewable energy in Africa – key challenge of the sustainable development goals. *Renew. Sustain. Energy Rev.* 75, 393–401. doi:10.1016/J.RSER.2016.11.004

Soeleman, S., and Lestari, S. D. (2015). The role of sukuk financing for sustainable development of smallholder farmers. *Australas. Account. Bus. Finance J.* 8 (5), 79–92. doi:10.14453/aabfj.v8i5.5

Song, H., Zhao, C., and Zeng, J. (2017). Can environmental management improve financial performance: an empirical study of A-shares listed companies in China. *J. Clean. Prod.* 141, 1051–1056. doi:10.1016/J.JCLEPRO.2016.09.105

Tol, R. S. J. (2018). The economic impacts of climate Change. 12 (1), 4–25. doi:10.1093/REEP/REX027

Wang, X., Van Wart, M., and Lebredo, N. (2014). Sustainability leadership in a local government context: the administrator's role in the process. *Public Perform. Manag. Rev.* 37 (3), 339–364. doi:10.2753/PMR1530-9576370301

What is climate change (2025). What is climate change? United Nations. Available online at: https://www.un.org/en/climatechange/what-is-climate-change?utm_source=chatgpt.com (Accessed November 14, 2025).

Wynes, S., and Nicholas, K. A. (2018). Reply to second comment on 'the climate mitigation gap: education and government recommendations miss the most effective individual actions. *Environ. Res. Lett.* 13 (6), 068002. doi:10.1088/1748-9326/aac9cf

Ye, J., and Dela, E. (2023). The effect of green investment and green financing on sustainable business performance of foreign chemical industries operating in Indonesia: the mediating role of corporate social responsibility. *Sustain. Switz.* 15 (14), 11218. doi:10.3390/su151411218

Glossary

Renewable Energy (RE)	Energy from naturally replenished sources such as solar, wind, and biomass that generate electricity with low or zero greenhouse gas emissions
Residential Renewable Energy	Use of renewable technologies (mainly rooftop solar PV) installed on or around private homes (villas and apartments) to generate electricity for household use
Rooftop Solar Photovoltaics (PV)	Solar panels mounted on building roofs that convert sunlight directly into electricity for on-site consumption
Net Zero by 2050 Strategic Initiative (UAE)	The UAE's national strategy to reach net-zero greenhouse gas emissions by 2050, including large-scale deployment of clean energy
Greenhouse Gas (GHG) Emissions	Heat-trapping gases (e.g., CO_2, CH_4) released by human activities that contribute to global warming and climate change
Climate-Risk Awareness / Fear and Awareness of Global Warming	The degree to which individuals understand and are concerned about climate change and its potential impacts
Adoption Intention (for Renewable Energy)	A household's stated likelihood or willingness to install and use renewable energy technologies in the near future
Competitive Financial Price	Perception that renewable energy systems are financially attractive compared with conventional grid electricity, considering upfront cost, payback period, and bill savings
Perceived Economic Benefits	Belief that adopting renewable energy leads to lower energy bills, potential financial savings, and/or higher property value
Environmental Attitudes	Personal beliefs and values regarding environmental protection, resource conservation, and responsibility toward sustainability
Social Norms / Community Influence	Perceived expectations, examples, or pressures from family, neighbours, and society that encourage or discourage renewable energy adoption
Policy Incentives / Government Role	Government measures (e.g., subsidies, net metering, tariffs, regulations, awareness campaigns) that support or promote renewable energy uptake
Cross-Sectional Survey	A research design in which data are collected from a sample at a single point in time to examine relationships between variables
Likert Scale	A rating scale (e.g., 1 = strongly disagree to 5 = strongly agree) used to measure attitudes, perceptions, and intentions
Factor Analysis	A statistical technique that groups related survey items into underlying constructs (factors), such as "economic benefits" or "policy trust."
Regression Analysis	A statistical method used to estimate the strength and direction of relationships between a dependent variable (e.g., adoption intention) and multiple independent variables (e.g., costs, attitudes, incentives).