Energy Strategy Reviews 38 (2021) 100732

Contents lists available at ScienceDirect

Energy Strategy Reviews

journal homepage: www.elsevier.com/locate/esr

Attitudes towards climate change and energy sources in oil exporters

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ARTICLE INFO

Keywords:
Energy preference
Expatriate
Life satisfaction
Public perception
Transient residency
Climate change

ABSTRACT

Switching to energy mixes that use more non-fossil fuels is critical to reduce greenhouse gas emissions to tackle climate change. Climate change poses a major challenge to oil exporting Gulf countries, like the rest of the world, but research on human views on energy and climate change is limited. We aim to fill this gap by focusing on the UAE, a nation with a peculiar demographic composition that includes an overwhelming proportion of expatriates and transitions towards green and nuclear resources. We examine whether transiency of residence and life satisfaction play a role in influencing perceptions about climate change and energy sources. We also analyze how expatriates' opinions differ from UAE citizens who have significantly higher income and welfare benefits.

1. Introduction

Over the last several decades, social scientists have been studying climate change and global warming extensively [1]. While the terms "global warming" and "climate change" are often used interchangeably, global warming is just one component of climate change. Climate change, on the other hand, refers to long-term changes in weather conditions that occur on Earth over time.[1] Human activity such as the emission of carbon dioxide (CO2) and other greenhouse gases (GHG) into the atmosphere, which has exacerbated global warming for many decades, are largely to blame [2]. Accordingly, to mitigate the effects of climate change by reducing GHG emissions requires a phase out in fossil fuel consumption and shift to more sustainable power generation by changing the energy mix to include larger shares of green and, arguably, nuclear energy. This shift in energy balance presents policymakers with many obstacles in terms of preparing and implementing emerging technology, and among these challenges, public support/resistance and attitudes toward non-fossil fuel energy sources demand particular attention.

Public support for energy projects is a critical step to reduce costs and delays [3–5] and public views regarding climate change will influence national climate change policies [6]. To this end, it is critical to weigh the trade-offs between promoting a specific energy source and being concerned about climate change. Although there are studies indicating that concern about climate change has a positive effect on influencing positive attitudes toward green energy sources, there has been little attention on Gulf countries on this issue.

There is limited information regarding attitudes towards energy sources and climate change in the Gulf region. This research uses survey data from the United Arab Emirates (UAE), a member of the Gulf Cooperation Council[2] (GCC), to fill this gap. We focus on a Gulf state because the GCC owns about 40% of the world's known oil reserves and 21% of the world's known gas reserves [7] and contains three of the top ten oil producers.[3] Some may argue that since these countries depend heavily on oil revenues, green energy is not an energy option they are willing to introduce. According to 2016 statistics, four of the top 10 countries that emit carbon dioxide based on a global ranking of CO2 emissions (metric tons per capita) are GCC members.[4] These figures, however, do not portray the growth of renewable energy projects in the area.

GCC countries have a variety of reasons/incentives to diversify their energy mix and invest in green energy. First, climate change poses significant threats to these nations, potentially jeopardizing their food security, water production, and public health [8]. Thus, the integration of renewable energy technologies in the power generation sector would result in decreased CO2 emissions. Second, diversification of the energy

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[1] https://climate.nasa.gov/resources/global-warming-vs-climate-change/.
[2] GCC countries consist of Bahrain, Kuwait, Oman, Qatar, Kingdom of Saudi Arabia and the United Arab Emirates.
[3] Kingdom of Saudi Arabia, United Arab Emirates and Kuwait.
[4] https://data.worldbank.org/indicator/EN.ATM.CO2E.PC?most_recent_value_desc=true.

https://doi.org/10.1016/j.esr.2021.100732
Received 14 April 2021; Received in revised form 3 October 2021; Accepted 10 October 2021
Available online 14 October 2021

mix would reduce the fossil fuel dependence and improve long-term energy stability [9]. Finally, aside from cost concerns, clean energy implementation will have important environmental advantages [10].

The case of the United Arab Emirates, which recently linked its first nuclear power plant to the grid, seems to be of particular importance among Gulf countries [11]. By 2050, the UAE plans to have the majority of its energy mix composed of renewable (44%), followed by a 38% of gas, 6% nuclear and the remaining 12% from fossil fuels [12]. As of 2018 (latest available data), most of the electricity is generated via natural gas. *Total electricity generation from natural gas is 133 739.*0 GWh *(with a share above 98%), and oil is 953.*0 GWh *in 2018.*[5] This process adds significantly to the country's CO2 emissions. Natural gas was responsible for 140 MT CO2 in 2018, compared to 45 MT for oil and 8 MT for coal. The UAE's primary source of CO2 emissions is electricity generation, supplemented by the manufacturing and transportation activities [13]. Since 2010, however, a range of renewable energy technologies, such as solar PV, wind power, and waste-to-energy, have become economically viable in the UAE, with technology costs, especially for solar PV systems, rapidly dropping [14].

A large body of research analyzed the factors that influence life satisfaction, including the effect of climate change. For example, it seems that more months with higher temperatures are linked to lower levels of life satisfaction [15]. However, there is a scarcity of studies on the impact of life satisfaction on attitudes towards climate change. Are individuals who are more satisfied and happier about their lives more worried or skeptical about climate change? Government's efforts to promote happiness may have positive or negative consequences for attitudes toward climate change. This is particularly relevant for the UAE, which has designated a Minister of State Happiness. Moreover, the UAE has one of the highest GDP per capita in the world, ranking 22nd globally in 2019 [16], presents highly diverse demographics and serves as a home away from home for many expats [17]. Rapid economic growth, advancement, and access to a global workforce have resulted in this diversity. With the influx of shopping centers, restaurants, and resorts at the expense of natural and cultural spaces, this development has greatly altered the country's landscape. It has also led to the obesity rates in a hyper-consumerist environment [18], as well as significant wage disparities [19], with UAE nationals receiving significantly more and getting access to a range of welfare benefits [20]. All these aspects of UAE provide a unique environment in which to see whether transiency of residence is linked to a greater degree of awareness or skepticism towards climate change.

This research makes at least two contributions: first, it leads to closing the awareness gap in the UAE about individual[6] views on climate change and energy sources; second, it examines whether transiency of residence and life satisfaction have a significant effect in shaping views on energy sources and climate change. Through developing awareness in terms of public understanding of climate change, this study aims to contribute to the planning of policies under the strategic context identified in the National Climate Change Plan of the United Arab Emirates 2017–2050 [21]. This analysis is also applicable to other Gulf countries such as Kuwait, Bahrain and Saudi Arabia, which share similar characteristics and considerable risks due to climate change.

The following is how the rest of the paper is organized: section 2 summarizes the literature on perspectives on climate change and energy sources; section 3 introduces the model and study design; section 4 presents the findings, section 5 discusses the results; and section 6 concludes.

[5] https://www.iea.org/countries/united-arab-emirates. Accessed July 17, 2021.

[6] Although research has been conducted with a focus on the UAE in the areas of climate change and energy from mostly a macro point of view [22–24], there is lack of literature in terms of individual views in the UAE (and the wider Gulf region).

2. Background

2.1. Views towards energy sources and climate change

IEA [25] states that energy security and climate change mitigation are two important objectives faced by policymakers. Accordingly, nuclear power and renewable energy emerge as the main alternative energy sources to overcome these two challenging objectives. When considering nuclear energy, it seems key to evaluate perceived benefits and risks of nuclear energy to determine acceptance. Corner et al. [26] discusses the concept of conditional support; that is, positive view towards nuclear energy as long as it contributes to tackling climate change. This is aligned with the concept of reluctant acceptance of this energy source, as it had already been observed in the literature focusing on the case of the UK [27; 28] and Turkey [29,30]. According to this view, if tackling climate change is viewed as a plausible benefit, nuclear energy acceptance might rise under limited circumstances.

Nuclear power acceptance is influenced by not only perceived benefits for the climate but also by risk perception [31]. Among factors that affect risks perceptions, trust towards nuclear power organizations and governments appears to be of paramount importance [31–33]. However, if renewable energy sources are provided as an alternative to nuclear energy in these studies, the conditional support for nuclear energy decreases [26,27,29].

There are also a number of other factors that can lead to a positive view towards nuclear energy such as decreased electricity production cost compared to fossil fuels, less sensitivity to variations in fuel prices than fossil-fueled generating plants and increased nuclear plant safety [34]. However, despite climate change concerns, both Corner et al. [26] and Ertor-Akyazi et al. [29] find that respondents with strong environmental beliefs may be cautious in their endorsement of nuclear power whereas Spence et al. [35] finds that both environmental and climate change concerns are linked with positive evaluations of renewables and negative evaluations of nuclear power.

Studies related to public perception of renewable energy find that support for this type of energy source tends to be high. Concern towards climate change seems to be one of the main reasons for positive support towards renewable energy sources [27,29,30,36,37], albeit it might not necessarily be the main driver of support [38]. Improved energy security, nuclear power abandonment, energy transition and stabilizing national economies can be cited as some of the other factors for positive support towards renewable energy sources [39,40] This positive support, however, may also depend on the type of renewable energy source [36] where wind power/farms, for example, may create contradictory perceptions.

Individuals presenting a greater attachment at the global level, as opposed to local or national level, tend to be more concerned about climate change and, in turn, more favorable towards renewable energy sources [41]. This is strictly related to the topic of transiency of residence that we aim to investigate in this study: all else equal, individuals who spend only part of their life in the country might present a relatively lower level of local attachment. Yet, they might be developing a feeling of gratitude towards the country that has welcomed them [17], especially if they are satisfied with their life in the UAE. On the other hand, UAE nationals are definitely expected to present high levels of place attachment at the local level, stemming from a documented pride of being a UAE citizen [42].

All in all, a multitude of factors shape views towards energy sources and climate change. These include knowledge about climate change, environmental concern, socio-demographic characteristics [29,30,36], political views [26,36], beliefs and opinions [43], perceived risk/benefit/cost [44], and place attachment [41]. Furthermore, the direction of associations and the magnitude of effects is likely to differ between nations (32). It has also been shown that happiness can foster trust and support towards the government [45]; thereby individuals more satisfied with their life could be more prone to support different government

initiatives in the energy sector, including nuclear and fossil.

2.2. The case of the UAE

The United Arab Emirates (UAE) is a remarkable example of a country with a widely diverse population. It has been a major destination for immigrants (expatriates/non-nationals) and is one of the top six immigration countries (relative to population) with a migrant share of 88.5% [46]. Nationals make up 11.5% of the population, 60% of the total workforce in the public sector but only 0.5% of the private sector's workforce in 2013 [47]. Although recent demographic data by nationality is not available, estimates suggest that expatriates from South Asian countries (India, Pakistan, Bangladesh) constitute the top-ranking nationalities [47,48]. Since there is no path to citizenship and their stay is linked to their working status, these expatriates only stay in the country for a limited time. However, some expatriates may reside in the country for several years and even for generations where it is possible to have second or even third-generation descendants of expatriates. On average, expatriates stay in the UAE around 9 years and almost 31% of the expatriates (aged 10 and above) have been residing in the country for ten years and more based on 2005 census data [47].

2.3. Previous research on views towards climate change in the UAE

Amidst generalized lack of attention towards the Middle East, some information on views towards climate change is available thanks to international polls. According to a comparative study conducted by YouGov [49], respondents sampled from the UAE presented one of the largest shares of deniers of anthropogenic causes of climate change (6%), with greater shares only shown by Saudi Arabia (7%), Egypt (7%), Norway (8%), and USA (9%). A considerable share of UAE respondents (16%) also indicated that it might be too late to avoid the worst effects of climate change, more than Saudi Arabia (12%) and much more than Kuwait (9%). However, the vast majority of UAE respondents believed climate change would have an impact (either a great deal or a fair amount). In another poll that focused on usage of air conditioning (AC) in the UAE, it was found that a concerning 62% of respondents tend to leave their AC on whilst leaving the house [50]. As these results were presented at the overall level, it is not possible to distinguish potential effects of transiency of residence.

3. Research design

3.1. Data collection

Data was collected through an online survey in 2015, following non-probabilistic quota sampling. The survey was conducted by the company YouGov MENA, with survey invitation sent via email to potential participants belonging to the target population. The survey contained questions on socio-demographic characteristics, views on different energy sources, concern towards climate change, questions on life satisfaction, and questions to determine the extent of transiency of residence. Furthermore, additional questions were asked to explore the beliefs on climate change. Quotas on age, gender and nationality groups were set to be in line with the target population: UAE residents aged 18 and above.

3.2. Variables and hypotheses

In this study, we aim to mainly explore the public attitude towards the use of various energy sources and climate change through an opinion survey in the UAE. In particular, evaluating UAE residents' and expatriates' perspectives on the use of various energy sources and personal feelings of worry about climate change, we aim to expose the linkages among the transiency of residency, life satisfaction and perspectives on climate change. The following three hypotheses were explicitly chosen to be investigated within our study:

H1: As per the literature, we assume that one's beliefs on climate change can influence one's views on energy sources. Hence, we hypothesize that people who are more concerned about climate change are more likely to embrace renewable energy sources.

H2: Although the influence of transiency of residence on climate change and energy sources is ambiguous, this influence is likely to rely on the characteristics of transient residents (i.e. the feelings of expats living a good life in the UAE might be infused with gratitude). Therefore, we hypothesized that there is a link between these characteristics of residences of UAE and their acceptance of (even more problematic) energy sources like nuclear and fossil fuels.

H3: We hypothesize that those who are happier in the UAE are more likely to support any energy source and to be less concerned or more optimistic about the subsequent effects of climate change in the UAE.

Table A1 in Appendix presents the complete list of variables and related descriptions. Views on energy sources were captured by asking respondents to state to what extent the UAE should invest in a specific energy source. This question was designed following Pidgeon et al. [27]. We identified three different segments: nuclear_promoter (would want the UAE to invest in nuclear), renewable_promoter (would want the UAE to invest in solar and/or wind), fossil_promoter (would want the UAE to invest in gas and/or coal and/or oil). In line with the literature, we assume that views regarding climate change can contribute to affect views towards energy sources. In particular, the expectation is individuals who are more concerned tend to be more favorable towards renewable energy sources.

Global concern towards climate change was measured on a scale from 1 meaning 'not concerned at all' to 10 meaning 'Very concerned'. This question is adapted from a similar one used as part of a survey tracker launched by the European Commission [51]. We defined 'Concerned' as individuals who indicated a rating of 7 or higher. Additionally, respondents were asked to share their view on a set of statements around climate change to assess whether they tended to be skeptical about climate change risks in the UAE, as well as to determine whether they acknowledged the anthropogenic causes. We followed in this case Islam et al. [52] and Matthews [53]. With the collected information, we isolated, in a deterministic way, four segments: consequence (individuals who believe consequences of climate change in the UAE in the short and long term are likely to be experienced), emissions (emissions in the UAE are likely to contribute to climate change), temperature (temperature increase in the UAE is likely to happen), and skeptics (impacts of climate change are over-emphasized and/or climate change is the result of natural climate variability and/or the Earth has a natural mechanism that protects itself). We need to emphasize that this latter group could include both strong and more moderate skeptics. The hypothesis in this instance is as follows: individuals who belong to the segments of the consequence, temperature, and emissions would tend to support renewable energy sources and nuclear energy over fossil fuels, all else equal. On the other hand, we may expect greater support towards fossil fuels from the skeptics.

In order to determine transiency of residence, respondents were asked to indicate when they were planning to leave the UAE, if at all. We also asked how many years they had been residing in the country. The impact of transiency of residence on climate change views and energy sources is ambiguous and it is likely to depend on the characteristics of the transient residents, including whether gratitude pervades the feelings of expatriates who are leading a successful life in the UAE. These factors might lead them towards greater acceptance of even more problematic energy sources, such as nuclear and fossil fuels.

To assess whether respondents were satisfied with their life in the UAE, life satisfaction was asked on a scale from 1 to 10, where 1 indicated 'Not satisfied at all', and 10 'Completely satisfied'. This is defined as evaluative account of well-being [54]. Following Cheung and Lucas [55], we employed a single item scale. We defined 'Satisfied' as individuals who provided a rating of 7 or higher. We assume life

satisfaction to negatively affect transiency of residence: namely, individuals happier in the UAE will tend to stay in the country for a longer period of time. Furthermore, our hypothesis is that individuals who more satisfied with their life in the UAE would tend to be more supportive of any energy source and more optimistic about the impacts of climate change in the UAE. We also asked to what extent respondents felt that their life so far was worthwhile, and how happy they were the day before the interview (short term happiness) in order to conduct robustness checks.

3.3. Econometric model

We employ a multivariate probit model [56] to simultaneously model determinants of concern towards climate change and views towards energy sources, as well as the determinants of transiency of residence and life satisfaction. In particular, we specify 11 equations, each one characterized as follows:

$$\begin{cases} y_i = 1 \; if \; \beta_i X_i + \varepsilon_i > 0 \\ y_i = 0 \; if \; \beta_i X_i + \varepsilon_i \leq 0 \end{cases} \quad (1)$$

where $y_i$represents a dichotomous dependent variable, X_i represents a vector of explanatory variables, β_i are the vector of estimated coefficients, and ε_i are the random components. The ε_i are assumed to follow a multivariate normal distribution with zero mean, unitary variance, and correlation terms between the random components given by ρ_i. Simulated maximum likelihood estimation is implemented to estimate the parameters. The model is identified as long as at least one explanatory variable is not included in all the equations.

The group of variables included in the various set of equations and the assumed associations are displayed in the conceptual map in Fig. 1. Views towards climate change are assumed to affect views towards energy sources. Furthermore, we assume that transiency of residence might impact both. In turn, life satisfaction might affect transiency of residence as well as views towards climate change and energy sources. Finally, demographic variables are assumed to affect views towards climate change, energy sources, life satisfaction, and transiency of residency. The group 'views towards climate change' includes five variables (concerned, consequence, emissions, temperature, skeptics), whereas the group 'views towards energy' includes three variables (nuclear, renewable, fossil). Transiency of residence is operationalized by means of two dichotomous variables, indicating respondents planning to leave in the short term versus medium term. Socio-demographic variables such as the emirate of residence, age, nationality group, income, religiosity, marital status and having children are included across all equations. When assessing the determinants of life satisfaction, we also controlled for stated health, to what extent the respondent trusts others and whether the respondent resided for a relatively short time in the UAE (up to 2 years). The latter control was also included in the equations where transiency of residence was set as the dependent variable.

We also present results obtained by applying a factor analysis [57] to the climate change statements listed earlier. In this way, we can assess whether the latent factors that can be derived with this alternative methodology confirm the presence of concerned and skeptical individuals. Table A1 in the Appendix includes details of the variables used in this study.

4. Results

4.1. Sample characteristics

The questionnaire was completed by 1961 respondents residing in the UAE. 62 different nationalities took part in the survey, the majority being Indian (34%), Pakistan (11%), Philippines (10%) nationals and Emiratis[7] (10%). The nationality group distribution is aligned with the information available on the target population. 65% of the sample are men, and 50% reside in Dubai. Average age of the sampled respondents is 33.8 years. 47% are married with children and 7 in 10 stated to be in a full-time employment.

4.2. Transient residents

In order to identify transient residents, we refer to stated information provided by the respondents on their intended length of stay in the UAE at the time of the survey. Furthermore, we exclude UAE nationals from the segment of 'transients' and consider only expatriates for this purpose. We identify transiency in two ways. First, we identify the segment of those intending to leave the UAE within 5 years. We will refer to this segment as 'Transient short term'. Second, we consider the segment consisting of those who plan to leave within the next 5–10 years, referring to this as 'Transient medium term'. Fig. 2 shows the size of the transient segments compared to the rest of the sample: 20% are assigned to the group of the transient short term, and 17.4% to the group of transient medium term.

4.3. Views towards climate change

Most respondents indicated to be concerned about climate change. In particular, on a scale from 1 'Not at all concerned' to 10 'Very concerned', 21% stated to be very concerned. Almost 7 in 10 selected a value of 7 or higher. At the same time, it is important to investigate the presence of potential skepticism and the actual extent of concern towards climate change in the UAE (Fig. 3). Most respondents believe that climate change will have some negative effects. 59% believe it is very likely or likely that average temperature will increase in the UAE. 48% think climate change will have catastrophic consequences in the UAE in the long run. Yet, only 36% believe climate change will have catastrophic consequences in the UAE in the short term. Furthermore, 45% believe that UAE's emissions contribute to climate change. However, almost 3 in 10 think the impact is over-emphasized and 4 in 10 believe that climate change is the result of natural climate variability.

Fig. 4 presents the size of the segments Consequence, Temperature, Emissions, Skeptics, Concerned, and distinguishes by transient segments and UAE nationals. We will refer to the outcomes of tests of proportions to comment on whether differences between groups are significant. Transient individuals, especially short-term ones, seem more likely to believe climate change will have consequences in the UAE (z-score 1.79). Moreover, greater shares of transients are found in the segments Temperature, Emissions, and Concerned. At the same time, transient medium-term respondents present a significantly larger share of skeptics (z-score 1.61). UAE nationals are significantly less likely to declare to be concerned (z-score 2.72), to believe UAE's emissions contribute to climate change (z score 5.17), and that there will be consequences in the UAE (z-score 2.89).

4.4. Views towards energy sources

Information on views towards energy sources is presented in Fig. 5, distinguishing between UAE nationals and transient individuals. Respondents seem to support mostly investments in renewable energy sources and fossil fuels. This is particularly the case of medium term Transients: 85% support renewables and fossil fuels. Support towards nuclear energy is substantially lower, being the highest among UAE nationals (56.8%). In Appendix, figure A1, we report interesting combinations of promoters of energy source pairs where we observe the

[7] UAE nationals.

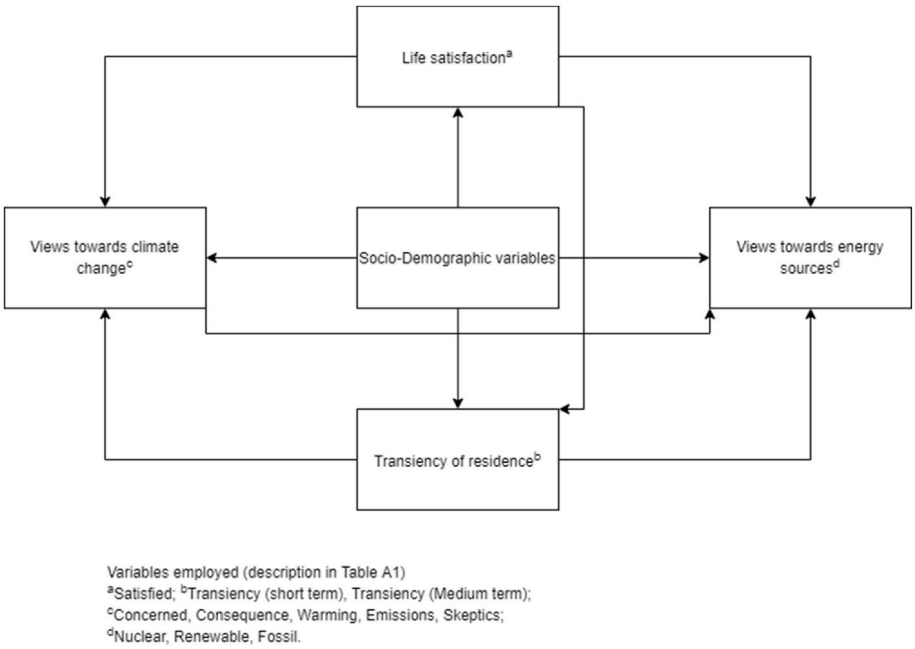

Fig. 1. Conceptual map.

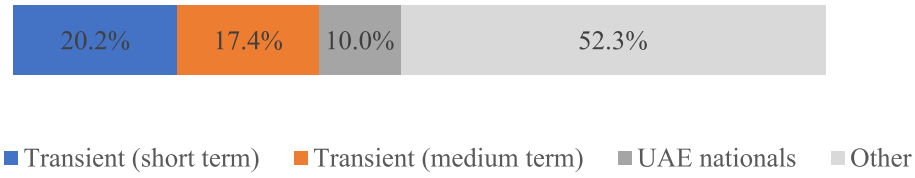

Fig. 2. Size of transient' segments versus rest of the sample (n = 1961).

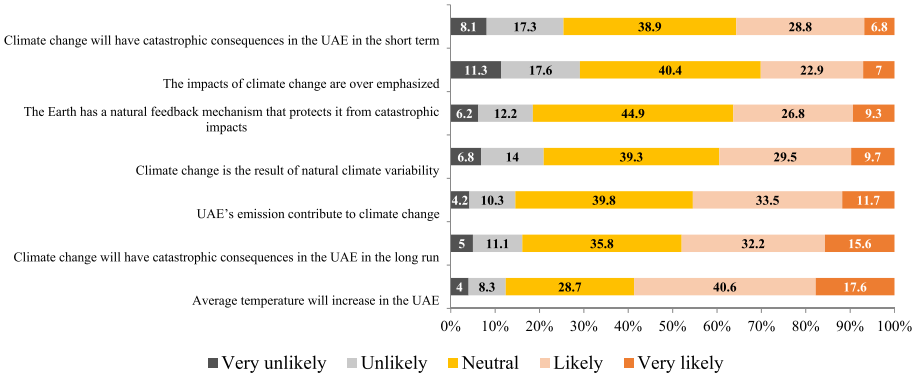

Fig. 3. Attitudes towards climate change (%, all respondents).

largest segment to be promoters of renewables and fossil fuels, followed by promoters of renewables and nuclear energy. We applied a series of tests of proportions to assess if the differences in percentages are significant. Non-UAE nationals are more likely to be renewable energy promoters (z-score 2.52), and among them transient residents (medium term) are significantly more likely to be promoters of this energy source (z-score 2.79). Similar findings are observed with respect to fossil fuels, with transient residents (medium term) significantly more likely to be promoters (z-score 2.59). When it comes to nuclear energy, we find that UAE nationals are significantly more likely to be promoters of this energy source (z-score 1.68).

4.5. *Life satisfaction*

Fig. 6 reports the share of individuals satisfied with their life in the UAE. UAE nationals are associated with the largest share (71%), significantly greater compared to the non-UAE nationals (z-score 3.18). Transient short-term residents, on the other hand, display the lowest share of satisfied (45.9%) which is in line with the expectation that individuals more satisfied with their life in the UAE tend to stay longer in the country.

In Appendix, figure A2, we also present the distribution of the additional data collected on subjective well-being (life satisfaction in the UAE, life satisfaction in general, short-term happiness, and life worthwhile). It can be observed that the distributions tend to be quite similar

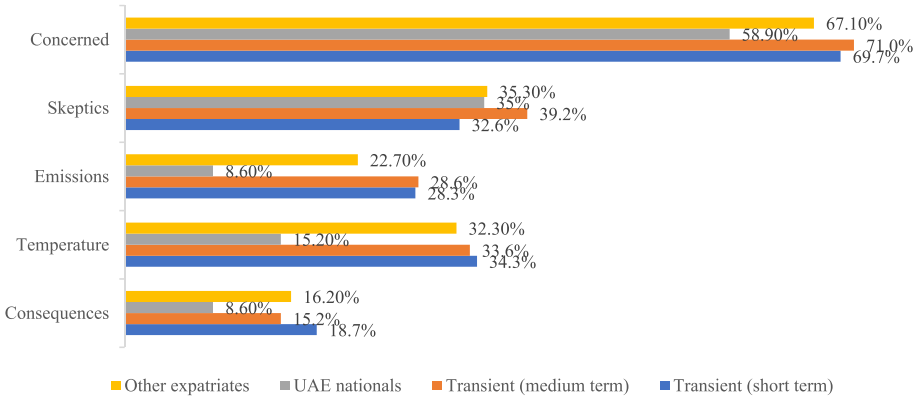

Fig. 4. Segments of attitudes towards climate change (% by segment).

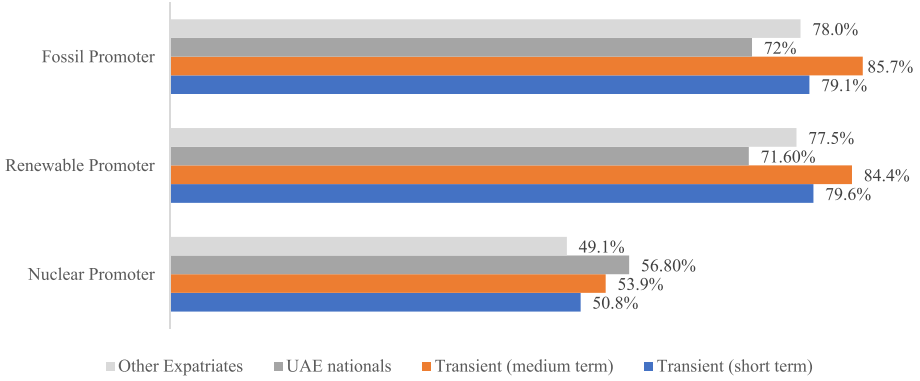

Fig. 5. Views towards energy sources (% by segment).

Fig. 6. Individuals satisfied with their life in the UAE (% by segment).

across different type of questions. There is significant positive correlation across all the pairs of measures considered, with the lowest one found between life satisfaction in the UAE and short term happiness (0.57), and the highest found in correspondence of life worthwhile and short-term happiness (0.68).

4.6. Econometric results

Econometric results are presented in Tables 1 and 2. In Table 1 we focus on the determinants of views towards climate change, whereas in Table 2, we present the results with respect to views towards energy sources, as well as the determinants of transiency of residence and life satisfaction. The null hypothesis that the ρ_i are simultaneously equal to zero can be rejected for a p-value lower than 1%. This means that the multivariate probit specification is preferred, in this instance, to a series of independent probit models.

UAE nationals seem to downplay the risks of climate change in the UAE: they are significantly less likely to perceive consequences of climate change in the UAE as likely to happen, that emissions in the UAE contribute to climate change, and that temperatures will increase in the UAE. In line with this, they are also more likely to be skeptical about climate change. Being religious seems to have a very similar impact, reducing the concern towards climate change locally; at the same time however, religious individuals are more likely to be concerned about climate change in general. Arab expatriates are significantly less concerned about climate change in general, and, similar to UAE nationals, less likely to agree there will be serious consequences in the UAE. Short term transient residents seem more likely to be concerned about climate change globally, whereas medium term transient residents appear more likely to be skeptics. It can also be noticed that the group of individuals that presents the strongest lack of concern towards climate change, both globally and locally, is represented by men.

When we look at the impact of life satisfaction, we can see that individuals who are more satisfied with their life in the UAE are more

Table 1
Multivariate probit part I-Views towards climate change.

	Consequence	Emissions	Temperature	Skeptics	Concerned
Transient (Short term)	0.184 (0.197)	0.092 (0.208)	0.068 (0.184)	−0.075 (0.160)	0.351* (0.182)
Transient (Med. term)	−0.253 (0.194)	0.025 (0.238)	−0.248 (0.220)	0.337* (0.182)	−0.279 (0.227)
UAE national	−0.806*** (0.193)	−1.06*** (0.184)	−0.978*** (0.165)	0.411*** (0.149)	−0.222 (0.160)
Arab	−0.227** (0.094)	−0.130 (0.082)	−0.161 (0.076)	−0.041 (0.072)	−0.622*** (0.077)
Male	−0.289*** (0.076)	−0.275*** (0.070)	−0.195*** (0.065)	0.190*** (0.064)	−0.158** (0.069)
Age	−0.000 (0.004)	0.001 (0.003)	0.002 (0.003)	0.003 (0.003)	0.002 (0.003)
Religious	−0.373*** (0.138)	−0.372*** (0.132)	−0.351*** (0.127)	0.382*** (0.128)	0.239* (0.132)
Degree	0.032 (0.077)	0.070 (0.070)	0.078 (0.065)	0.026 (0.062)	0.216*** (0.067)
Low income	−0.009 (0.075)	−0.101 (0.069)	−0.077 (0.064)	0.027 (0.060)	−0.029 (0.067)
Dubai	0.045 (0.087)	0.121 (0.078)	0.106 (0.072)	−0.111* (0.069)	0.082 (0.075)
Abu Dhabi	0.086 (0.100)	0.143 (0.090)	0.071 (0.084)	0.068 (0.078)	0.020 (0.085)
Married with kids	−0.039 (0.079)	−0.094 (0.072)	−0.002 (0.066)	−0.002 (0.061)	−0.086 (0.069)
Full_time	0.012 (0.082)	−0.026 (0.075)	−0.122 (0.069)	0.105 (0.067)	0.093 (0.072)
Satisfied	−0.223* (0.121)	−0.117 (0.122)	−0.216** (0.111)	0.307*** (0.098)	0.612*** (0.131)
Constant	−0.302 (0.226)	−0.170 (0.210)	0.126 (0.197)	−1.288*** (0.196)	−0.177 (0.207)
Observations: 1961.					
Log Likelihood: −9015.801.					

Level of significance: *** 1%, ** 5%,* 10%. Standard errors in parenthesis.

likely to be concerned about climate change in general, but less likely to be worried about its effect in the UAE. Specifically, individuals more satisfied with their life in the UAE are associated with a lower likelihood of foreseeing consequences of climate change in the country, and less likely to believe that temperatures will increase in the UAE. No significant impact is found in terms of whether UAE's emissions contribute to climate change.

The model also provides an overview of the determinants of transiency of residence and life satisfaction. Short term transient residents in the sample are more likely to be religious, residing in Dubai and of Indian or Philippines nationality. Instead, those married with kids are less likely to be transient. Those with a full-time jobs, even if with lower income, are more likely to be long term transient. Importantly, the level of life satisfaction affects the likelihood of short-term transiency, with those less satisfied with their life in the UAE planning to leave the country sooner. UAE nationals, religious individuals, women, those with higher income, better stated health and who trust others are more likely to be satisfied with their life in the UAE.

When we examine the determinants of view towards energy sources, we find that UAE nationals, Arab expatriates, men, older age groups, individuals with a degree and concerned with climate change in general are more likely to be promoters of nuclear energy. Concern towards increasing temperatures in the UAE is associated with a more positive view towards renewables, but also towards fossil fuels, hence not appearing to be a key driver for this energy preference. Religious individuals are also more likely to support investments in fossil fuels in the UAE. Finally, life satisfaction seems exclusively and positively affect views towards renewable energy, but not towards other energy sources. Transiency of residence, either short term or medium term, does not seem to affect significantly views towards energy sources in the UAE.

All in all, views towards climate change seem to affect to a limited extent the views towards energy sources; in turn, views towards climate

Table 2
Multivariate probit part II-Views towards energy, transiency and satisfaction.

	Nuclear Promoter	Renewable Promoter	Fossil Promoter	Transient (Short term)	Transient (Med. term)	Satisfied
Transient (Short term)	−0.052 (0.171)	0.125 (0.241)	0.028 (0.269)			
Transient (Med term)	0.103 (0.181)	−0.120 (0.208)	0.076 (0.209)			
UAE national	0.378** (0.182)	−0.277 (0.232)	0.303 (0.217)			0.506*** (0.177)
Arab	0.184** (0.095)	−0.033 (0.111)	−0.133 (0.112)	−0.090 (0.104)	−0.072 (0.105)	0.073 (0.093)
Indian	0.067 (0.077)	−0.025 (0.089)	0.007 (0.088)	0.245*** (0.089)	0.172* (0.091)	−0.165** (0.083)
Philippines	0.030 (0.118)	0.187 (0.137)	0.259* (0.141)	0.240* (0.135)	0.576*** (0.132)	−0.129 (0.123)
Male	0.564*** (0.071)	0.353*** (0.084)	0.310*** (0.083)	0.109 (0.081)	0.165** (0.084)	−0.195*** (0.072)
Age	0.006* (0.003)	0.005 (0.004)	0.002 (0.004)	0.006* (0.004)	0.005 (0.004)	0.001 (0.003)
Religious	0.082 (0.139)	−0.228 (0.183)	0.377** (0.155)	0.413*** (0.117)	0.555*** (0.128)	0.365*** (0.136)
Degree	0.231*** (0.067)	0.196*** (0.073)	0.149** (0.073)	−0.016 (0.075)	0.124 (0.079)	−0.021 (0.069)
Low income	−0.069 (0.066)	−0.014 (0.073)	0.113 (0.072)	−0.069 (0.074)	0.134* (0.077)	−0.283*** (0.066)
Dubai	0.000 (0.073)	−0.008 (0.083)	−0.025 (0.084)	0.171** (0.083)	0.132 (0.083)	−0.033 (0.075)
Abu Dhabi	0.086 (0.083)	−0.146 (0.092)	−0.065 (0.093)	0.055 (0.099)	−0.083 (0.103)	−0.010 (0.087)
Married with kids	0.085 (0.066)	0.043 (0.074)	0.047 (0.073)	−0.211*** (0.077)	0.040 (0.078)	0.110 (0.070)
Full_time	0.029 (0.072)	0.037 (0.081)	−0.022 (0.080)	0.129 (0.085)	0.157* (0.087)	0.011 (0.075)
Satisfied	0.186 (0.145)	0.262* (0.148)	0.199 (0.163)	−0.388*** (0.130)	0.006 (0.126)	
Consequence	0.059 (0.168)	0.111 (0.215)	−0.065 (0.218)			
Emissions	−0.048 (0.158)	0.168 (0.188)	0.019 (0.199)			
Temperature	0.348** (0.148)	0.665*** (0.200)	0.685*** (0.193)			
Skeptics	−0.022 (0.149)	0.343* (0.189)	0.305 (0.202)			
Concerned	0.460*** (0.161)	0.334 (0.215)	0.399* (0.217)			
Health						0.156*** (0.016)
Trust_people						0.130*** (0.014)
Resided_2_years				0.405*** (0.083)	0.105 (0.087)	−0.200** (0.080)
Constant	−1.463*** (0.240)	−0.274 (0.307)	−0.657** (0.300)	−1.52*** (0.213)	−2.23 (0.228)	−1.559*** (0.239)
Observations: 1961.						
Log Likelihood: −9015.801.						

Level of significance: *** 1%, ** 5%,* 10%.

change appear to be affected, at least partially, by transiency of residence and life satisfaction. Life satisfaction, at the same time, appears to impact transiency of residence and, finally, there seems to be a set of socio-demographic variables significantly affecting simultaneously views towards climate change, energy sources, life satisfaction, and transiency of residence: these are gender, particular nationality groups (i.e. UAE nationals) and being religious.

4.7. Robustness checks

In this section, we conduct a few additional analyses to assess the robustness of the findings. We apply a factor analysis with maximum likelihood method to the statements around climate change in the UAE and extract two factors, based on the cumulative variance explained (95%). Further, varimax rotation was applied. The two factors extracted confirm the presence of two groups of individuals: a group concerned about the effects of climate change in the UAE, and another group that appear to be much less concerned and rather skeptical. The corresponding factor loadings and uniqueness values are presented in Table 3 below.

For the factor 'Concerned', consequences_long_term and temperature_increase present the greatest values of the factor loadings (0.84 and 0.70 respectively). Furthermore, consequences_long_term is associated to the lowest uniqueness, indicating greater relevance of the variable in the factor model. Instead, natural_climate_variability has the greatest factor loading and lowest uniqueness when it comes to the factor "Skeptics". Based on these factor loadings and individual's ratings, we computed individual score factors and assessed the differences in means among key groups, with results presented in Table 4.

Results confirm that individuals more satisfied with their life in the UAE present a significantly greater score for the factor Skeptics. With regards to views towards energy sources, it can be observed that renewable promoters score significantly higher in terms of concern, presenting a greater score compared to promoters of other energy sources. Finally, considering transient residents, medium term residents seem associated with higher average values for both factors, indicating substantial degree of heterogeneity within transient residents.

5. Discussion of results

The UAE is a country that is relatively well-positioned in terms of financial resources that can be used to fund mitigation and adaptation measures, but it is critical to implement appropriate programs as quickly as possible. In this regard, gaining knowledge and awareness of the public's viewpoints is a critical prerequisite for developing a plan of incentives to encourage low-carbon living in the country.

As we hypothesized in section 3.2 (Hypothesis 1), people significantly more concerned about climate change seem to be more likely to embrace renewable energy sources in line with the results of previous studies (27,29,30,36,37). Individuals who have been in the UAE for a longer period of time, as well as those who are more content with their lives in the UAE, appear to downplay the risk of climate change locally while being more concerned about climate change in general.

Our findings, which emphasize the importance of perceptions about the future of the environment in determining preferences for renewable and nuclear energy, provide further interesting results about the Gulf Region. UAE citizens appear to be more supportive of nuclear energy deployments while being less concerned about the consequences of climate change in the UAE and more skeptical of climate change concerns in their own country. Lack of public participation in nuclear energy policy undertaking, which poses certain hazards to present and future generations, may indicate a legitimacy issue [58]. Nonetheless, because the majority of UAE nationals and residents support nuclear energy [59], this would not be a worry in the UAE, unlike in some other countries where the public is strongly opposed to nuclear energy [27,30,32,33]. Individuals who are much more concerned about local implications of climate change appear to be more supportive of renewable energy sources, which is consistent with earlier research [26–29,60]. According to prior study, they are also more likely to endorse and follow government activities [45]. Life satisfaction appears to have a significant negative impact on local climate change concern across the sample. Moreover, as anticipated in section 3.2 (Hypothesis 3) those who are happier in the UAE not only are less concerned about the subsequent effects of climate change but also more likely to support renewable energy in the UAE. This finding necessitates a more extensive examination of the impact of happiness on climate change, which would necessitate a different emphasis of investigation than the more usual assessment of the impact of climate change on happiness. The rationale behind the use of behavioral economics to policy is that humans stray from mainstream economic theory's axioms and assumptions. As such, our finding about the life satisfaction and support for renewable energy can be used as a framework to help policy actions be more effective [61]. The link between length of stay and people's acceptance of energy sources such as nuclear and fossil fuels is another noteworthy finding worth exploring in our study section 3.2 (Hypothesis 2). Although temporary residents are concerned about climate change in general, they may be less motivated or more difficult to persuade to adopt pro-environmental habits if they do not recognize the hazards of climate change locally. This finding raises serious concerns because it might be extrapolated to other Gulf countries with big expatriate populations and significant climate change risks.

Our study has certain limitations; thus, our results should be assessed and interpreted with caution. First, our survey data, as is the case with the majority of survey-based studies, are only cross-sectional and therefore do not allow us to control for unobservable and time invariant elements that very well may be important determinants of the perceptions on climate change, energy sources and life satisfaction. Replication of our findings with longitudinal data would help moderate the related bias. Second, although we use a rich data set formed by countrywide

Table 3
Factor analysis results (varimax rotation).

Variable	Factor 1: Concerned	Factor 2: Skeptics	Uniqueness
consequences_short_term	0.6512	0.2267	0.5245
consequences_long_term	0.8478	0.0414	0.2796
emissions_contribute	0.6991	0.1524	0.4881
temperature_increase	0.706	0.1979	0.4624
earth_natural_feedback	0.2288	0.6545	0.5194
natural_climate_variability	0.175	0.7807	0.3598
impacts_over_emphasized	−0.0009	0.6949	0.517

Uniqueness: indicates the variance unique to the variable considered. The variables Concerned and Skeptics are the score factors obtained from the factor analysis.

Table 4
Differences in score factors by key groups of respondents.

	Concerned (score factors)		Skeptic (score factors)	
Group of respondents	Mean	T statistic	Mean	T statistic
Not satisfied	0.010	0.3945	−0.090	−3.72***
Satisfied	−0.006		0.052	
Non-Nuclear Promoter	−0.045	−2.139**	−0.032	−1.628**
Nuclear Promoter	0.043		0.031	
Non-Renewable Promoter	−0.353	−9.129***	0.020	0.530
Renewable Promoter	0.096		−0.005	
Non-Fossil fuel Promoter	−0.222	−5.566***	−0.139	−3.623***
Fossil fuel Promoter	0.058		0.036	
Non-Transient (Short term)	−0.006	−0.571	0.008	0.777
Transient (Short term)	0.022		−0.028	
Non-Transient (Med. term)	−0.014	−1.529*	−0.017	−1.83**
Transient (Med. term)	0.066		0.076	

Level of significance: *** 1%, ** 5%.

representative and heterogeneous surveys containing individual sentiments, our sample is limited to participants in the United Arab Emirates. While GCC and other regional countries share common characteristics in their market and institutional conditions, individual cultural and environmental factors may impact the perceptions of individuals on climate change and energy sources. Thus, our results on certain parts may not be externally valid outside the UAE. Third, between the time of the survey used here (2015) and at the time of our empirical analysis (2021), public perception on the topics covered in his study may have changed. Nonetheless, we believe that the above-mentioned associations, as established by our research, have not changed significantly and are still particularly useful as they are the only results on the subject for the UAE. If there are any changes, especially in the aftermath of the COVID-19 pandemic, future surveys and studies on the topic should assist us in identifying them. Finally, as in any other survey-based examinations, non-response bias and measurement error are concerns in our study. Nevertheless, our study provides openings for further research to examine and expand upon our findings.

6. Conclusion and policy implications

This study aims to contribute bridging the knowledge gap around UAE nationals' and expatriates' perspectives on various energy sources and climate change, as well as the linkages between these perspectives, transiency of residence and life satisfaction. We discovered that, on a global and local level, both transiency of residency and life satisfaction have considerable effects on influencing perspectives on climate change. Although more research is needed to determine the impact of additional determinants on perspectives on climate change in the UAE and the Gulf, this study accentuates the necessity of highlighting local climate change threats to the public and raising awareness of the region's significant risks.

Our findings provide an inclusive understanding of the relationship between transient residency and carbon-reduction attitudes which would have ramifications in terms of policymaking. The UAE introduced a new system for long-term residency visas in 2019 allow foreigners to live, work, and study in the UAE without the need for a national sponsor, a common system used to monitor migrant laborers in GCC member states and a few neighboring countries.[8] In terms of historical significance, this is a big and important shift in the UAE's immigration laws. The relationship between individual's residency duration in a country and their concerns about that country's environment, as shown by our findings, implies that policymakers should pay attention to this relationship when establishing such arrangements, especially in the context of Gulf Countries where a large body of expatriates live. Because a significant number of respondents are doubtful about the detrimental effects of climate change in the UAE, specialized communication campaigns and education programs are required. Initiatives such as Be'ati Watani [62], Sustainable Future [63], and the UN climate change accreditation for teachers [64] are all in this direction. Nonetheless, there appears to be room for development, for example, in terms of expanding the program to include more age groups of the population, as well as a better presence in school curricula. In addition, because life satisfaction appears to have a significant impact, combined programs backed by both the UAE Ministry of Climate Change and Environment and the Ministry of Happiness would need to be assessed.

In addition to educational initiatives, effort should be prioritized to assess incentives to drive lower carbon lifestyles. Lack of concern and skeptical aptitudes might be associated with much lower willingness to take action [35] There is ample need for research in this area to reduce waste production, promote recycling, optimize water and electricity consumption, just to name a few. The UAE has the highest per capita waste generation in the world [65], and while the government has set a goal of reducing municipal solid waste that would otherwise go to landfills by 75% by 2021 [66], more research is needed to determine how to best encourage citizens and residents to recycle and reduce waste production. In this study, we found that UAE nationals and those satisfied with their life in the UAE tend to be particularly less concerned about climate change locally. Coincidentally, these individuals tend to also have higher income levels implying that they could contribute the most in reducing emissions at the household level if appropriately incentivized [67].

Credit author statement

The authors confirm contribution to the study as follows:Davide Contu: survey conception and survey design, data collection, manuscript preparation, Methodology, writing, review & editing. Ozgur Kaya: survey conception, manuscript preparation, interpretation of results, writing, review & editing. Ilker Kaya: manuscript preparation, Funding acquisition, writing, review & editing All authors reviewed the manuscript, results and approved the final version of the manuscript.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

This work was supported by the Economic and Social Research Council (N. 1350515) and American University of Sharjah (FRG20-S-B127). The work in this paper was supported, in part, by the Open Access Program (OAP-SBA-074) from the American University of Sharjah and this paper represents the opinions of the author(s) and does not mean to represent the position or opinions of the American University of Sharjah.

Appendix

Table A1
List of variables and their coding (Climate change related)

Variable	Survey item wording/variable description	Response scale
concern_climate_change	*How concerned are you, as individual, about climate change?*	1: not at all concerned, …, 10: completely concerned
	Climate change refers to drastic weather conditions and extreme events over long time periods. How likely do you think is that … ?	
concequences_short_term	*Climate change will have catastrophic consequences in the UAE in the short term*	

(*continued on next page*)

[8] The validity of stay on a residence visa varies according to its type and the sponsor. It can be for 1, 2 or 3 years. According to a change in 2019, a residence visa can also be issued for 5 and 10 years subject to certain conditions (the UAE Government portal, https://u.ae/en/#/).

Table A1 (*continued*)

Variable	Survey item wording/variable description	Response scale
concequences_long_term	*Climate change will have catastrophic consequences in the UAE in the long run*	1: Very unlikely
emissions_contribute	*UAE's emissions contribute to climate change*	2: Unlikely
temperature_increase	*Average temperature will increase in the UAE*	3: Neutral
earth_natural_feedback	*The Earth has a natural feedback mechanism that protects it from catastrophic impacts*	4: Likely
natural_climate_variability	*Climate change is the result of natural climate variability*	5: Very likely
impacts_over_emphasized	*The impacts of climate change are over emphasized*	
Concerned (y_1, x_1)	*Selected 7 or above in concern_climate_change*	1: belongs to the segment 'concerned', 0 otherwise
Consequences (y_2, x_2)	*Selected 4 or 5 in consequences_short_term and 3 or 4 in consequences_long_term and not skeptic*	1: belongs to the segment 'consequences', 0 otherwise
Emissions (y_3, x_3)	*Selected 4 or 5 in emissions_contribute and not skeptic*	1: belongs to the segment 'emissions', 0 otherwise
Skeptic (y_4, x_4)	*Selected 4 or 5 in earth_natural_feedback or in natural_climate_variability or in impacts_over_emphasized and not belonging to consequences, emissions or temperature segments*	1: belongs to the segment 'skeptic', 0 otherwise
Temperature (y_5, x_5)	*Selected 4 or 5 in temperature_increase and not skeptic*	1: belongs to the segment 'temperature', 0 otherwise
List of variables and their coding (Socio-Demographic variables)		
Male (x_6)	*Gender: male*	1: male, 0 otherwise
National (x_7)	*Nationality: UAE national*	1: UAE national, 0 otherwise
Arab ()	*Nationality: Arab expat*	1: Arab expat, 0 otherwise
Indian (x_9)	*Nationality: Indian national*	1: Indian national, 0 otherwise
Philippines national (x_{10})	*Nationality: Philippines national*	1: Philippines national, 0 otherwise
Age (x_{11})	*age expressed in years*	from 18 to 69 years old
Religious (x_{12})	*Follows a religion*	1: religious, 0 otherwise
Degree (x_{13})	*Has at least a university degree*	1: has a university degree, 0 otherwise
Income_10K (x_{14})	*Has an income of up to 10 000 AED* per *month*	1: has an income up to 10K AED per month, 0 otherwise
Dubai (x_{15})	*Resides in the emirate of Dubai*	1: resides in Dubai, 0 otherwise
Abu_Dhabi (x_{16})	*Resides in the emirate of Abu Dhabi*	1: resides in Abu Dhabi, 0 otherwise
Married_kids (x_{17})	*Married with kids*	1: married with kids, 0 otherwise
Full_time (x_{18})	*Has a full-time employment*	1: has full time employment, 0 otherwise
Resided_2_years (x_{19})	*Has resided in the UAE for up to 2 years*	1: has resided in the UAE for up to 2 years, 0 otherwise
List of variables and their coding (Life satisfaction, Transiency, Energy views)		
Life_satisfaction_UAE	*Please think for a moment about how satisfied are you with your life. On a scale from 1 to 10, where 1 means "Not at all satisfied" and 10 means "Extremely satisfied", how satisfied are you with your life in the UAE?*	1: not at all satisfied, …, 10: extremely satisfied
Life_satisfaction	*Please think for a moment about how satisfied are you with your life. On a scale from 1 to 10, where 1 means "Not at all satisfied" and 10 means "Extremely satisfied", how satisfied are you with your life in general?*	1: not at all satisfied, …, 10: extremely satisfied
Life_Worthwhile	*On a scale from 1 to 10, where 1 means "Not at all worthwhile" and 10 means "Extremely worthwhile", to what extent do you believe the things you do in life are worthwhile?*	1: not at all worthwhile, …, 10: extremely worthwhile
Happiness_short_term	*On a scale from 1 to 10, where 1 means "Not at all" and 10 means "Extremely", how happy were you yesterday?*	1: not at all happy, …, 10: extremely happy
Satisfied (y_6, x_{20})	*Selected 7 or above in Life_satisfaction_UAE*	1: belongs to the segment 'Satisfied', 0 otherwise
Health (x_{21})	*How would you rate your health?*	1: very bad, …, 10: very good
Trust_people (x_{22})	*To what extend do you trust others?*	1: not at all, …, to a great extent
Transient (short term) (y_7, x_{23})	*Plans to leave the UAE within the next 5 years*	1: plans to leave the UAE within the next 5 years, 0 otherwise
Transient (medium term) (y_8, x_{24})	*Plans to leave the UAE within the next 5 to 10 years*	1: plans to leave the UAE within the next 5–10 years, 0 otherwise
Nuclear Promoter (y_9, x_{25})	*Would want the UAE to invest a lot or some in nuclear energy*	1: nuclear energy promoter, 0 otherwise
Renewables Promoter (y_{10}, x_{26})	*Would want the UAE to invest a lot or some in either wind, solar*	1: renewable energy promoter, 0 otherwise
Fossil Promoter (y_{11}, x_{27})	*Would want the UAE to invest a lot or some in either gas, coal, oil*	1: fossil fuels energy promoter, 0 otherwise

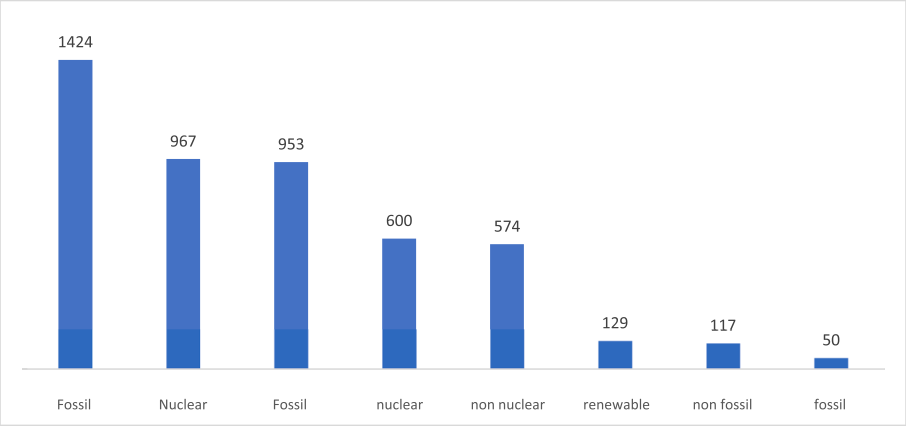

Fig. A1. Views towards energy sources (promoters), size of segments' combinations (counts)

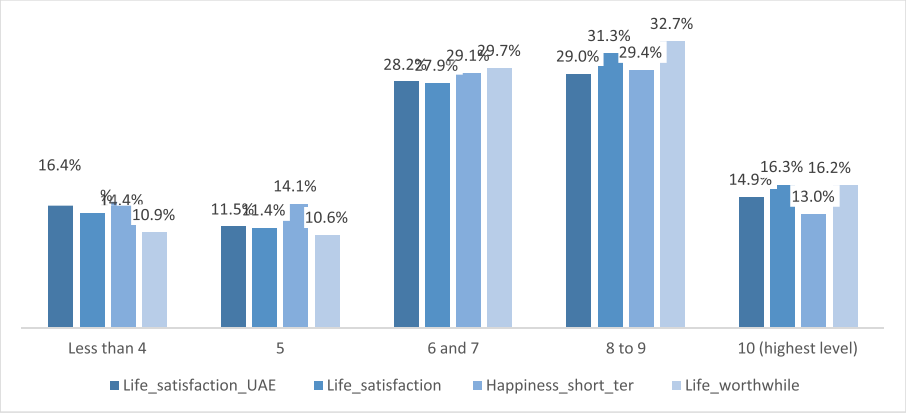

Fig. A2. Stated subjective well-being (% of total sample)

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