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Awareness and Perceptions of University Students in the Business College towards Energy Savings and Renewable Energy Sources in Saudi Arabia

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ABSTRACT

Achieving sustainable development goals and realizing the goal of Kyoto Protocol, Paris Agreement and Glasgow Climate Pact to keep the world temperature rise lower than 2°C above pre-industrial levels, there is a need to engage some of the stakeholders who are part of the energy users in a society. Majority of the Saudi citizens are youths and a large number of them are still undergoing university education. This study assessed the awareness, perception and attitudes of university students in the college of business towards energy savings and renewable energy (RE) in the Eastern province of Saudi Arabia. The results using descriptive analysis revealed that the level of awareness of students about energy savings and renewable energy is at medium level. While few of them are concerned about energy-savings and RE usage, many of them are indifferent, which could be as a result of their poor knowledge and awareness about it. At least 3 out of 5 students believed that fossil fuels have negative impact on the environment. Furthermore, the results of logistic regression indicate that there is no statistical difference between gender, age and awareness of energy savings and RE. More so, the results also show that energy education and family factors are statistically significant in influencing students' awareness of energy savings and RE. Appropriate government policy in university academic curriculum which incorporates energy savings and renewable energy education is recommended in order to realize the government Vision 2030 which is also in line with the UN Climate goal.

Keywords: Energy Savings, Renewable Energy, University Students, Energy Education, Energy Awareness

JEL Classifications: A22, O13, Q20, Q42, Q54, Q58

1. INTRODUCTION

Energy occupies a central position in human's life as it cuts across all aspects of affairs of human being. It has contributed in driving economic growth, propel research and technology innovation, improve the quality of life of people, boost international trade, and develop human capital among others (Wang and Guo, 2021; Akinwale, 2021a; Akinwale and Muzindutsi, 2019; Adepoju et al., 2018). However, the economic growth path of many developed and emerging countries was not environmentally friendly as it constitutes mainly fossil fuel and gases which emit carbon and other hazardous gases (Akinwale, 2018a). This led to the

depletion of ozone layers and negatively affect the environment. Despite the Kyoto Protocol and the Paris Agreement on climate change, the sea level has risen in the recent time and the earth temperature is rising at an unprecedented rate, which comes with various devastating health and environmental issues (Dubois et al., 2019). However, many countries and activists have made further pledge to further reduce the greenhouse gas emission in the UN climate conference, the Glasgow Climate Pact, known as COP26 in November 2021 (Maizland, 2021). The plan is to keep the world temperature rise lower than 2°C above pre-industrial levels and to continuously make efforts to limit the rise to 1.5°C. Since the whole world would be adversely affected by the outcomes of

the greenhouse gas emission resulting into global warming, it is necessary for all countries to take various actions to reduce the level of carbon emission. This led to the emergence of energy savings and utilization of renewable energy resources.

Renewable energy resources are the energy resources which their regeneration rate are faster than their utilization rate (Karasmanaki and Tsantopoulos, 2019). This includes solar energy, wind energy, biomass and hydro energy among others. It is well documented that renewable energy (RE) is a sustainable energy path to economic development as these RE resources do not emit hazardous gas or emit little in some other cases (Adepoju and Akinwale, 2019). This seems to be in line with the global sustainable development goals (SDG). Kingdom of Saudi Arabia (KSA) is currently an energy dependent country, and it is blessed with abundance of crude oil, gas and renewable energy such as energy from the sun. The country is the world's largest producer of oil which makes fossil fuel usage easier and cheap for its residents. It is interesting to note that residential sector consumes more than half of the aggregate energy consumption in the country while industrial sector consumes one-fifth of the national energy (Akinwale, 2018b; Alrashed and Asif, 2015). However, the country based on its Vision 2030 targets to: diversify its economy from oil, increase its citizen's life expectancy at birth to 80 years, and have three Saudi cities among the top-ranked 100 cities in the world among other goals (Saudi Vision 2030 document, 2021; Akinwale, 2021b). All these would only be feasible if the environment is free from carbon emission and its aftermath effects. Meanwhile, Saudi Arabia production path to economic growth would not be negatively affected if conservation policy and renewable energy economic growth path are chosen and implemented in the country as shown by some studies (Akinwale, 2018b; Payne, 2010).

Energy saving, reducing carbon emission and utilization of renewable energy go beyond the action of government alone, but also cut across the attitudes and actions of individual households, firms, financial institutions, research institutions and universities among other stakeholders. Since individual households are the major users of energy in most countries, their understanding, awareness and knowledge of energy becomes very important to the success of the low carbon energy path the government might implement (Yazdanpanah et al., 2015). A well informed, energy literate community is more prepared to make a better and energy efficient decisions and actions (DeWaters and Powers, 2011). The individual daily habits in terms of the usage of household appliances (refrigerators, cookers, air condition), food, transportation, lightning and heating among others constitute the larger proportion of energy consumption (Tukker and Jansen, 2006; Hertwich, 2005). This constitutes an approximately three-quarter of greenhouse gas emission emanating from the households (Hertwich and Peters, 2009), and this cannot be underplayed. Low public awareness has been attributed to one of the challenges which made some of the renewable energy projects failed (Estrada-Vidal and Tójar-Hurtado, 2017; Valderrama-Hernández et al., 2017; Akinwale and Ogundari, 2017). Energy literacy awareness of the youths could contribute largely to the reduction of carbon emission as this would guide their daily behavior regarding energy consumption (Dubois et al., 2019; Zhao et al., 2019).

Since youths constitute two-third of the Saudi population and majority of them are students (Saudi Arabia General Authority of Statistics, 2020), their knowledge and attitude towards a particular technology would shape the usage of such technology. It becomes pertinent to understand the level of awareness and perception of university students in KSA regarding energy savings and renewable energy as this would shape the energy consumption path of the country. More so, there are differing results from the studies conducted in various countries, and majority of the study focused mainly on engineering students (Eshiemogie et al., 2022, Alawin et al., 2016). While there is a dearth of study on the level of awareness and perception of students on energy saving and RE in Saudi Arabia, there are very few studies on students from Business College, despite that this set of students are the future managers and the decision makers of organizations. Hence, this study investigates the level of awareness and perception of university students in the college of business administration in the Eastern province of Saudi Arabia. The remaining part of this manuscript include sections 2 to 5 which discuss the empirical literature of the study, methodology, result analysis and conclusion.

2. LITERATURE REVIEW

This section discusses the empirical literature which have been conducted in some other countries relating to students' awareness and perceptions of energy savings and renewable energy utilization. Altuntaş and Turan (2018) in their study conducted among the 600 secondary school students in Turkey on their awareness of RES, and the results revealed that the students' awareness was at an intermediate level and there was a significant correlation between their cognitive and affective awareness. Meanwhile, the awareness of students differ on grade level, their source of information and course of study. The study of Eshiemogie et al. (2022) carried out among engineering students in Nigeria regarding their awareness and perception of renewable energy found that an overwhelming majority averred that they are aware of renewable energy but only one-quarter are confident of their understanding of renewable energy. More so, both male and female engineering students in Nigerian universities have the same level of understanding of renewable energy. Meanwhile similar study (Olanipekun and Iyiola, 2020) was carried out among the university students in South West region of the country, and the results showed low level of awareness of the negative influence of energy usage. Zhao et al. (2019) explored the energy-saving behavior and attitudes of undergraduate students in Macau, and the results indicated that three-quarter of the students avowed that energy-saving is closely related to their daily lifestyle, and overwhelming majority of them believed that it is essential to save energy and also have energy-saving education in the universities. The results also confirmed positive and significant correlation between energy-saving education and energy-saving awareness among the students. Hao et al. (2019) confirmed the positive and significant influence of environmental awareness and knowledge of Chinese college students on the acceptance of nuclear energy in Beijing.

The result of the study conducted by Alawin et al. (2016) in Jordan among the private and state universities signaled that there is low

level of awareness about renewable energy among the engineering students. Similar result was found among An-Najah national university's students in Palestine in the study investigated by Assali et al. (2019). Zerinou et al. (2020) assessed the attitudes of both students and their parents in the Orestiada metropolis in Greece, and the outcome revealed that both groups of respondents had great extent of environmental awareness which has significantly transformed into actual behaviors of energy saving habits and practices.

Baharoon et al. (2016) examined the public's knowledge and attitudes of both urban and rural households in Yemen regarding renewable energy resources, and the results revealed a moderate level of knowledge from both of them. Meanwhile, the public in both locations are more familiar with solar and wind, but are less familiar with geothermal. The result also showed that the households indicated great interest in the use of renewable energy and willing to pay more for electricity generated from renewable energy. This result is similar to the results obtained in the study conducted in the south west Nigeria by Akinwale et al. (2014). Derasid et al. (2021) found that teachers and polytechnic lecturers have good awareness of renewable energy in Malaysia and also understand the role of government policies in boosting renewable energy implementation. While they are both optimistic of the deployment of solar energy in Malaysia, they are pessimistic regarding the deployment of wind energy. The sources of their knowledge are mainly from textbook, journals, internet and electronic media. However, male respondents have better understanding of RE than the female respondents.

The results of the level of awareness of energy saving and renewable energy differ from one country to another, signaling the inconclusiveness of research in this area of research. More so, the paucity of the study on the awareness and perception of students regarding energy savings and RE in top oil producing country (KSA) necessitates this research.

3. METHODOLOGY

The data in this study was obtained from August 2021 to February 2022 in the Eastern Province of the Kingdom of Saudi Arabia. Information was elicited from university students from two universities (Imam Abdulrahman Bin Faisal University and Prince Mohammed Bin Fahd University) regarding their awareness and perceptions of energy savings and renewable energy. Purposive sampling technique was used to focus on the students from the College of Business due to the paucity of research on the students from this college, and random sampling technique was utilized to obtain information from the students of the college of business administration without restricting to some particular students within the college of business through an online survey platform.

The questions are obtained from some of the related previous studies and adapted to suit the Saudi environment. This includes the sociodemographic factors, energy education, source of information regarding energy, level of awareness of energy saving and renewable energy (measured in 5-likert scale from very low to very high extent), and perception towards energy savings and

renewable energy (measured in 5-likert scale from very rarely to almost always) among others. The total of 264 undergraduate students responded to the survey within the period of study. The results are analyzed with descriptive and logistic regression techniques.

4. DISCUSSION OF RESULTS

Table 1 reveals that majority of the students (67%) are within the age bracket of 17-20 years, 32% are within the age of 21-25 years while the remaining 1% are within 26-30 years old. This implies that majority of the respondents are in their late teens and early twenties, and are expected to have been exposed to energy savings and utilization at this age. Both female (57%) and male (43%) students are well represented in the responses obtained. Table 1 further shows that majority of the respondents (60%) avowed that they have never taken any energy savings and renewable energy course previously. Meanwhile, the source of respondents' awareness about renewable energy was also enquired, and 53% of them asserted that they first heard of renewable energy from their teachers or in their schools but not as a course, whereas 30% of them claimed they first read about it from the internet and 9% of them first heard of it from their family and friends. This reflects the importance of the kind of information students could get formally or informally from schools as well as on the social media as these constitute mainly the source of their awareness regarding renewable energy. This result is in line with the outcome of some previous studies (Zerinou et al., 2020)

The cognitive knowledge of the students was enquired and reported in Table 2. Majority of the students asserted that heating/cooling of the apartment (52%), lightning the house (22%) and refrigerating (15%) constitute the most energy used in their houses. Table 2 also shows that only 35% of the students agreed that energy STAR © appliance uses less energy, while majority (56%) of

Table 1: Demographics, energy education and sources of awareness of students' RE

Characteristics	Description	F	%
Age (years)	17-20	178	67.4
	21-25	84	31.8
	26-30	2	0.8
	Above 30	0	0.0
	Total	264	100
Gender	Female	150	56.8
	Male	114	48.2
	Total	264	100
Have you taken energy course before?	Maybe	52	19.7
	No	158	59.8
	Yes	54	20.5
	Total	264	100
Sources of awareness of renewable energy	School/Teacher	139	52.7
	Magazine	7	2.7
	Family & Friends	24	9.1
	TV/Radio	13	4.9
	Internet	78	29.2
	Others	3	1.1
	Total	264	100

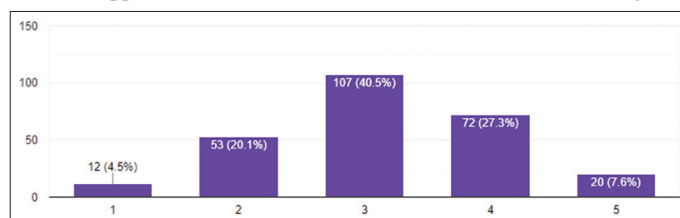
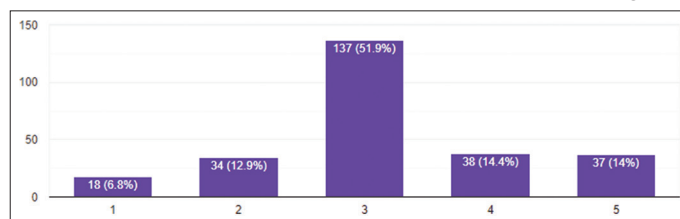
Table 2: Cognitive knowledge of undergraduate students

	Description	F	%
Which of the following do you think uses the most energy in an average home in Saudi Arabia	Cooking	30	11.4
	Heating & Cooling	136	51.5
	Lightning the house	58	22.0
	Refrigerating	40	15.2
	Total	264	100
Energy STAR © appliance uses less energy	Strongly Disagree	19	7.2
	Disagree	5	1.9
	Neutral	148	56.1
	Agree	67	25.4
	Strongly Agree	25	9.5
	Total	264	100
It is better to buy appliance that uses more energy than the one that uses less energy	Strongly Disagree	74	28.0
	Disagree	83	31.4
	Neutral	61	23.1
	Agree	40	15.2
	Strongly Agree	6	2.3
	Total	264	100
Fossil fuel such as crude oil does not have any negative impact on the ozone layer	Strongly Disagree	83	31.4
	Disagree	81	30.7
	Neutral	75	28.4
	Agree	17	6.4
	Strongly Agree	8	3.0
	Total	264	100

them are indifferent. More so, 59% disagreed with using high energy consumed appliances whereas approximately one-quarter of the respondents are neutral on the use of high energy consumed appliances. The last two sentences indicate that a sizable number of students are confused and did not understand what energy STAR © appliances are, but majority prefer to use appliances which consume less energy. Majority of the students (62%) also believed that fossil fuels have some negative impacts on the ozone layer while 28% are neutral and 10% don't believe the negative impact of fossil fuels on the ozone layer.

Figure 1 shows the extent to which the students are aware of energy savings and/or energy efficient appliances, majority of them (41%) opined that they have medium-level of awareness of energy savings, 35% have high-level of awareness while 24% have low-level of awareness of energy savings. This indicates most of the sampled undergraduate students have moderate level of energy savings. This result is similar to that of Figure 2 where the students were asked about the extent of their awareness regarding the energy sources (renewable energy) that regenerate itself faster than it consumed. Half of the students also claimed to be aware of this renewable energy sources at the medium level leaving 28% of them to have high-level awareness of renewable energy sources.

Solar, wind and hydro constitute the main renewable energy sources the students are aware of, while biomass is the least they

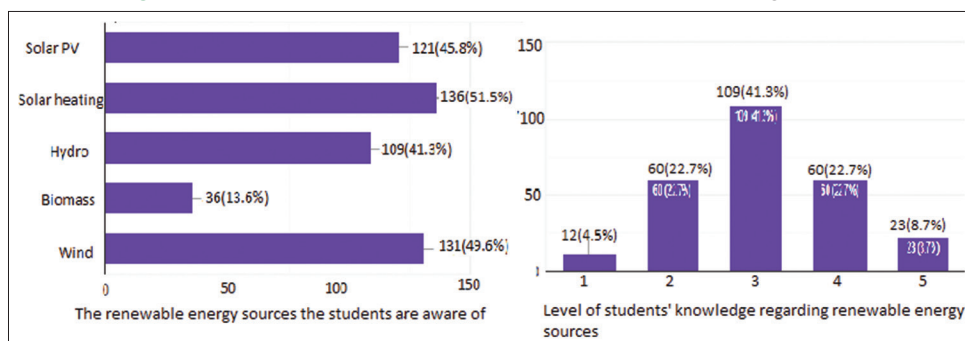
Figure 1: Level of students' awareness of energy savings and/or energy efficient appliances, 1 denotes the Lowest while 5 denotes the Highest**Figure 2:** Level of students' awareness of energy sources that regenerate itself faster than it consumed, 1 denotes the Lowest while 5 denotes the Highest

are aware of, as shown in Figure 3. When further enquiry was made regarding their level of knowledge of renewable energy, only 30% of them have high-level knowledge of renewable energy while the majority have medium-level to low-level knowledge of renewable energy.

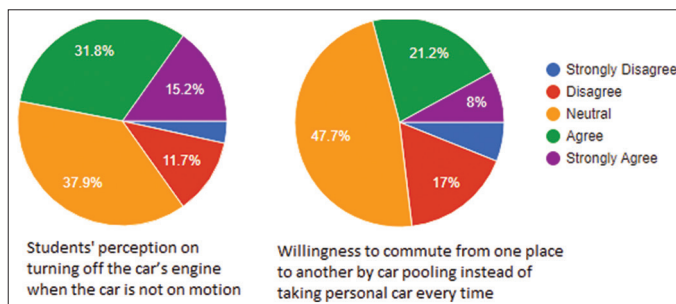
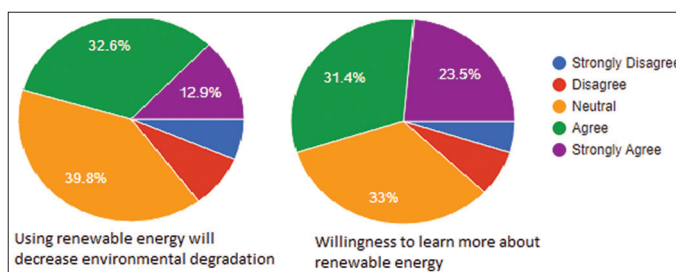
Table 3 discloses the perception of students towards energy savings in their house, and 30% of the students always prefer to go to short distance such as playing-ground park and religious centers within their neighborhood with cars, 29% sometimes prefer to go with car whereas 41% rarely go to these locations with their cars as they preferred walking instead. More so, Table 3 also reflects that majority of the students avowed to switch off the light when leaving the room as well as turning off the computer when it's not being used, though more than one-quarter of them sometimes or rarely engage in such actions. In addition to that, approximately 38% of the respondents averred that their daily actions are often influenced by their thought on energy use and only 40% affirmed that their family often discuss energy savings in their home. This seems a bit lower than expectations considering their level of education as undergraduate students. Table 3 also discloses that majority of the students (42%) considered themselves as medium energy user, whereas 12.5% always try to save energy and 20.1% of them sometimes try to save energy.

Figure 4 also shows that majority of the students (63%) are either neutral or disagree with turning off the car's engine when the car is not on motion such as when they go to religious centers to pray or when they visit retail stores for short period. Also, most of the students are either neutral or not willing to join others in carpooling to move from one location to another as they prefer to move with their own personal car. This could be as a result of low price of gasoline compared with the average income level of Saudi citizens.

Furthermore, Figure 5 shows that 45% of the students agreed that their usage of renewable energy could decrease environmental degradation, the remaining students (55%) are neutral and/or disagreed that their renewable energy usage decreases

Figure 3: RES that students are aware of and their level of knowledge of RES**Table 3: Students' attitudes to energy savings**

Variables	Description	F	%
I prefer to go to short distance such as religious centers and playground with a car instead of walking	Almost always	37	14.0
	Often	41	15.5
	Sometimes	78	29.5
	Rarely	42	16.0
	Very rarely	66	25.0
	Total	264	100
I always turn off the light when I leave the room	Almost always	136	51.5
	Often	56	21.2
	Sometimes	51	19.3
	Rarely	16	6.1
	Very rarely	5	1.9
	Total	264	100
My computer is always turned off when it's not being used	Almost always	114	43.2
	Often	41	15.5
	Sometimes	59	22.3
	Rarely	31	11.7
	Very rarely	19	7.2
	Total	264	100
My daily actions are influenced by my thoughts on energy use	Almost always	39	14.8
	Often	62	23.5
	Sometimes	113	42.8
	Rarely	33	12.5
	Very rarely	17	6.4
	Total	264	100
How would you describe yourself when it comes to energy usage	High energy user	18	6.8
	Moderate high energy user	49	18.6
	Medium energy user	111	42
	I try to save energy sometimes	53	20.1
	I always try to save energy	33	12.5

Figure 4: Perception of students on car's energy savings**Figure 5:** Perception about the effect of RE usage and willingness to learn more about RE

energy while 33% of the students are neutral. This indicates that many students would be happy if renewable energy is introduced as a course or an aspect of a general course which is a compulsory module for all the students in the business college. This is similar to the outcomes of few studies (Zerinou et al., 2020; Zhao et al., 2019)

The effect of sociodemographic factors on students' awareness of both energy savings and renewable energy was also tested using logistic regression. The results as shown in Table 4 reveal that age, education, family and gender have positive effect on students' awareness of energy savings and renewable energy. This is reflected in their positive coefficient values, and their odd ratios which are greater than one. Furthermore, while education and family are statistically significant in influencing students' awareness at 1% level in both panels of energy savings and renewable energy, age and gender are not statistically significant.

The outcomes of this study show that majority of the students (80%) in the college of business have not taken energy saving and/or renewable energy course before the period of the survey, and this could be as a result of the fact that it is not included in

environmental degradation. Figure 5 also discloses that majority of the students (55%) are willing to learn more about renewable

Table 4: Impact of Socio-Demographic Factors on Students' awareness of energy savings and renewable energy sources

Panel	Panel A: Awareness of Energy Savings			Panel B: Awareness of Renewable Energy Sources		
Variables	B coefficient	P-value	Odds ratio	B coefficient	P-value	Odds ratio
Age	0.33	0.1556	1.391	0.24	0.3114	1.271
Education	0.51	0.0006	1.665	0.37	0.0045	1.448
Family	0.40	0.0001	1.492	0.34	0.0016	1.405
Gender	0.23	0.3058	1.259	0.18	0.4223	1.197
Pseudo-R ²	0.25			0.23		
LR statistic	29.1	0.000007		22.2	0.000013	

their academic curriculum. In addition to this, most of them get to know about renewable energy through informal discussion with their teachers, social media and family. This indicates that academic environment, social media and family are important sources of information for the students, and hence these sources should ensure that good, genuine and reliable information are provided to the students.

It could be inferred from the study that majority of the students have medium-level of awareness of energy savings and renewable energy as few of them only have high-level of awareness of both energy savings and RE. This could be seen in the results as many students of the college of business do not understand energy efficient (energy STAR®) appliances and the need for their usage, so majority of the students are neutral regarding their usage. In addition to this, many undergraduate students are indifferent to switching off their cars' engine when they go to the stores or religious centers for a short period and neither are they interested in carpooling to commute as they prefer to move around with their personal cars. Approximately half of the students are aware of solar, wind and hydro but not biomass, though their knowledge level of these RES is low to medium-level.

Students of different ages and different gender are both aware of renewable energy in the same way. This implies that both male and female students of different ages have the same level of awareness of renewable energy in the College of Business. However, education and family factors are both statistically significant in gaining awareness of RE. This indicates that students who have studied any renewable energy related topics or courses are more aware of RE than those who have not, and also those that have family who discusses the concept of energy savings and RE tend to be aware of RE than those family who does not discuss the issues. Both energy education and social norm (family) would create more awareness about energy savings and RE among the students, hence reduce energy wastage and at the same time facilitate the rate of adoption of renewable energy. The result also shows that majority of the students are willing to learn more about renewable energy which is further buttressing the logistic regression results that energy education is highly important to create awareness about energy savings, renewable energy and low carbon driven economic system.

The implication of this result is that government policy in the education sector should ensure that energy education should be incorporated into the academic curriculum of university students. The knowledge of renewable energy and energy savings should not be limited to students in engineering and sciences, but should also

include students from other colleges such as college of businesses, arts, humanities and languages among others. Formulation and implementation of appropriate education policy would foster energy savings and/or renewable energy awareness and knowledge among the university students who are part of the present energy users and leaders of tomorrow. By so doing, there would be a drastic reduction of carbon and other gas emissions which contribute to global warming, so as to keep the world temperature rise lower than 2°C above pre-industrial levels and even restrain the rise to 1.5°C. This guarantees sustainable development by achieving economic growth without damaging the environment for both present and future generations.

5. CONCLUSION

Energy is an essential component of daily activities of the households, firms and government. Reducing gas emission that cause environmental degradation has become a contentious issue globally despite the daily need of these energy. This study investigated the awareness and perceptions of university students in the college of business in eastern province of Saudi Arabia. The results revealed medium-level of awareness of university students about energy savings and renewable energy. Majority of the students have not taken any course relating to energy savings/renewable energy, and their main sources of awareness are informal discussion with their teachers, social media and family. Few of them are conscious of energy savings in their daily activities whereas majority of them are neutral to energy savings/RE usage which could be as a result of their poor awareness and knowledge about it. However, most of the students indicate interest in learning more about renewable energy. Logistic regression revealed that age and gender are not statistically significant depicting that students of different ages and gender are having the same level of awareness of energy savings and renewable energy. More so, energy education and family factors are statistically significant in influencing the level of students' awareness of energy savings and RE. This suggests that students could learn much more from taking energy education course and discussion with their family members.

This study recommends that government through ministry of education should incorporate energy related course to the university academic curriculum as this will expose students from business and other colleges to energy savings and renewable energy, and shape their thoughts towards sustainable development goals. This would provide the university students requisite knowledge about energy savings and renewable energy which would form a good base for sustainable development, and also expose students to different business framework which they could deploy for those

that might want to start business in renewable energy sector after graduation. This would facilitate the realization of UN Climate change goal of reducing greenhouse emission and also achieving sustainable development goals of Vision 2030 of Saudi Arabia.

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