

# Investigating Factors Affecting the Adoption of Renewable Energy within Businesses in the Egyptian Market: An Exploratory Research

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Received: December 10, 2019    Accepted: January 20, 2020    Published: March 28, 2020

doi:10.5296/wjbm.v6i1.16017    URL: <https://doi.org/10.5296/wjbm.v6i1.16017>

## **Abstract**

This paper aims at discovering a suitable theory for understanding the adoption of renewable energy (RE) among investors and decision-makers in the Egyptian market as well as disclosing the research gaps related to examining the drivers that affect spreading RE sources in the various societies. Finally, it will explore the factors that influence the adoption of RE in different organizations to increase the diffusion of RE inside the Egyptian society. Therefore, it is important to understand how business customers select the type of energy whether conventional energy or RE or mixed. Hence, this study examines the drivers that influence business customers' choices of RE versus conventional energy for pushing toward adopting the RE investment inside the firms. Exploratory research is used in this investigation; therefore, data for this study is collected using literature reviews, international and local reports, in addition to unstructured interviews with potential and actual customers as well as practitioners and academics in the RE sector. This study will benefit Egyptian policymakers and RE companies in the marketing of RE sources through understanding the drivers of adopting RE within businesses.

**Keywords:** Theories and models of adopting RE, Diffusion of innovation theory, Business customers, Factors of adopting RE, The position of RE sector in the Egyptian market

## 1. Introduction

In recent years, RE has become the world's strategic choice to solve environmental pollution, handle the energy crisis and achieve sustainable development. Renewable energy (RE), refers to the energy that is produced by utilizing the natural resources that are continuously replenished and never run out such as solar energy, wind energy, bioenergy, hydropower energy, and so on (Australian Renewable Energy Agency, 2019; Wang, O'Donnell, & Brandt, 2017; Zhao, Noori, & Tatari, 2017). Due to the RE adoption, investment within businesses may play a significant role toward improving business performance through decreasing electricity costs that can be avoided in the long run and gaining other competitive advantages (Aladassy, Mosaad, & Tarabieh, 2016; OECD/IEA and IRENA, 2017). The institutions are increasingly being promoted encouraged to adopt RE sources instead of traditional energy by governments and RE companies. It may lead Egyptian economic growth to be enhanced through reducing Egypt's budget deficit, decreasing importing traditional energy sources, helping to reduce the unemployment rate, and reaching low carbon economy (Lehr & Hegazi, 2017; Sharaf, 2016).

This paper observed that the percentage of RE usage within business customers is low compared to their consumption of electricity which reached 41%, it may indicate that business customers are less enthusiastic to adopt RE (Arabic Egyptian Electricity Holding Company, 2016). Additionally, this study makes the main contribution to the prior studies of RE diffusion and contributes to achieve the strategic goal that was recommended by the World Bank and Egypt's vision 2030, which stated that RE should reach 35% or more and become the highest source for electricity generated in 2030 in the Egyptian market (Ministry of Planning, Monitoring and Administrative Reform, 2017; World Bank, 2017). Moreover, the findings indicate the most critical factors to improve the support to investors and decision-makers to increase adoption of RE investment.

## 2. Theories and Models of Interpreting Adoption of RE

In all the studies reviewed, there are the theories and models that interpreted the adoption phenomenon, but this study is designed to address the theories and models that have been utilized to understand how to adopt RE sources, as can be seen in Table 1.

For further details, Reyes-Mercado (2017) integrated the diffusion of innovation theory with cognitive frameworks for determining the factors that influence the adoption of solar energy technologies for urban households in Mexico (Reyes-Mercado, 2017). Similarly, Alam (2014) suggested a research model in accordance with the diffusion of innovation theory and the other theories that enhanced our perception of customer preferences toward RE use in Malaysia (Alam et al., 2014). As a result, the diffusion of innovation theory (DOI) can contribute to interpreting how, why, and at the rate of RE diffusion. Additionally, providing mechanisms for the communication of new ideas such as efficiency energy and RE use in the social system and proposing a set of attributes that construe the customer's decision of adopting RE (Mani & Dhingra, 2012; Rogers, 1995, 2003; Sharma & Mishra, 2014).

Table 1. Theories and models that used for explaining the adoption of RE

<b>Theory / Model</b>	<b>Constructs / Determinants of adoption</b>	<b>Studies applied theories for adopting RE</b>
Diffusion of Innovation Theory (DOI)	The innovation, communication, time and social system	(Reyes-Mercado, 2017) (Alam et al., 2014) (Lin & Huang, 2012)
Theory of Customer Value	Focuses on the comparison between the benefits and sacrifices by customers (individuals or organizations)	(Sangroya & Nayak, 2017) (Papista & Krystallis, 2013)
Theory of Reasoned Action (TRA)	<i>Behavioral intention, attitude and subjective norms</i>	(Zahari & Esa, 2016) (Ha & Janda, 2012)
Theory of Planned Behavior (TPB)	<i>Behavioral intention, attitude, subjective norms and perceived behavioral control</i>	(Park & Ohm, 2014) (Yun & Lee, 2015)
Behavioral Reasoning Theory (BRT)	Behavioral intention, attitude, subjective norms, perceived behavioral control and context-specific reasons	(Claudy, Peterson, & O'Driscoll, 2013)
Multi-level socio-technical Perspective (MLP)	Explains the dynamics between technology, norms, institutions, markets and society	(Sutherland, Peter & Zagata, 2015) (Osunmuyiwa & Kalfagianni, 2017)
Technology Adoption Model (TAM)	Perceived usefulness and Perceived ease of use	(Sharma & Mishra, 2014) (Viardot, 2013)
The Information-deficit Model	Interprets public understanding of science (PUS), which is interested in the connection between scientific knowledge in general and science and technology general perspectives	(Bidwell, 2016)

Source: Prepared by the researcher.

By contrast, Sangroya and Nayak (2017) used the theory of customer value to identify the factors that improve industrial green energy consumers relationship by investigating the impact of various dimensions of customer value on perceived switching costs in the industrial green energy market (Sangroya & Nayak, 2017). Similarly, Papista and Krystallis (2013) propose an integrated model of customer value in the green marketing context to help give a better understanding of customer behavior toward green brands by utilizing the theory of customer value (Papista & Krystallis, 2013). Accordingly, the customer value theory represents the main core in both management and marketing theory and practice. Generally,

there is an agreement regarding the definition of customer value, which points out the comparison among the gains and sacrifices of getting products through customers (Graf & Maas, 2008; Keränen & Jalkala, 2014; Sun & Su, 2012).

In contrast, Ha and Janda (2012) used the theory of reasoned action (TRA), and discovered that attitudes toward purchase energy-efficient products have a stronger effect on behavioral intentions compared to the subjective norms (Ha & Janda, 2012). Similarly, Zahari and Esa (2016) employed the theory of reasoned action (TRA) to recognize the drivers motivating the adoption of RE, as the results demonstrated that environmental concerns and relative advantages have more impact than consumer belief and consumer knowledge in the adoption of RE. As a result, the theory of reasoned action (TRA) declared that the prediction of intentions to implement a certain behavior depends on subjective norms and attitudes toward the behavior (Hai, Moula, & Seppälä, 2017).

On the other hand, Yun and Lee (2015) aimed to investigate the effect of attitudes, perceived behavioral control and subjective norms on consumer's intentions toward RE systems by using the theory of planned behavior (TPB) (Yun & Lee, 2015). Accordingly, TPB was developed through adding dimensions of Perceived Behavioral Control (PBC) to dimensions of the theory of reasoned action (TRA) (Hai et al., 2017; Sharma & Mishra, 2014; Yun & Lee, 2015). Conversely, Claudy et al. (2013) employed Behavioral Reasoning Theory (BRT) in an attempt to realize how consumers think regarding adopting RE. Hence, it included mediating dimensions such as reasons for or against adoption, and attitudes toward RE technology (Claudy et al., 2013). Commonly, behavioral reasoning theory gives a better understanding of consumer decision-making, because it presented a new dimension regarding context-specific reasons to the dimensions of the theory of planned behavior (Peattie, 2010; Westaby, Probst, & Lee, 2010).

Depending on the multi-level socio-technical theory, which aims at analyzing changes and stability in socio-technical systems, Sutherland et al. (2015) illustrated the importance of the agriculture sector for adopting RE through the agricultural policy. It can provide more opportunities for moving toward RE and affect many agricultural functions for adopting RE sources, for example, utilizing solar energy in the irrigation process instead of conventional energy. Accordingly, it is recommended that more interest should be paid to the impact of regime policies such as the agricultural policy on moving to RE use (Sutherland et al., 2015).

Moreover, Viardot (2013) applied the technology adoption model (TAM) to determine the various challenges of adopting RE and how to overcome those barriers to increase RE use (Viardot, 2013). As a result of technology adoption model (TAM), it aims at predicting the extent of adoption of new technology at an individual level (Sharma & Mishra, 2014). Eventually, Bidwell (2016) employed the information-deficit model, as it was discovered that the involvement in the information events contributes to changes in attitudes toward wind energy greatly (Bidwell, 2016). As a result of the information deficit model (IDM), it aims at explaining the public understanding of science (PUS) through interest in the connection between scientific knowledge in general and science and technology general perspectives. It is also called the knowledge gap model, the deficit model and knowledge deficit model (Bidwell, 2016; McDivitt, 2016).

### 3. Drivers of Adopting Renewable Energy (RE)

Despite growing articulated preferences for green products and environmental awareness, there are still slow rates of diffusion of sustainable energies. Recent trends toward sustainability issues have led to a proliferation of studies that demonstrated an increased interest in investigating many drivers, which may influence the RE diffusion in different organizations as indicated in Table 2. In the same vein, Claudy et al. (2013) recommended that more interest should be paid toward identifying attitudes, the reasons for or against adoption toward RE technology (Claudy et al., 2013).

In this context, some writers have attempted to divide the factors of adopting RE into two groups: In the first group are direct factors such as attitudes, subjective norms, perceived behavioral control and perceived cost. In the second group are indirect factors such as perceived social trust, perceived social support, perceived system quality, facilitating technical conditions, perceived trust, perceived benefits, knowledge and perceived risks (Park & Ohm, 2014; Yun & Lee, 2015). According to Noppers et al. (2016), they concluded that the symbolic attributes of sustainable innovations are improved and stressed by the policy, which took into consideration the symbolic attributes to boost the adoption of sustainable innovations. In addition, this study found that actual adoption of smart energy systems is explained by the symbolic attributes more than the other variables; they are instrumental attributes and environmental attributes (Noppers, Keizer, Milovanovic, & Steg, 2016).

In contrast, the findings by Sangroya and Nayak (2017) demonstrated clearly that customer loyalty toward green energy is affected through the impact of the dimensions of customer value (conditional value, functional value, social value, and emotional value) on perceived switching cost. In addition, conditional value has the biggest effect compare to the other dimensions of customer value for developing loyalty of industrial customers toward green energy (Sangroya & Nayak, 2017).

Furthermore, a willingness to pay (WTP) plays a key role in determining the level of RE acceptance, WTP can be estimated by using the contingent valuation (CV) method, which is most commonly applied to analyze consumer's preferences. For instance, employing the contingent valuation (CV) method for measuring Korean consumers' additional WTP toward RE sources. The results of WTP estimation indicated that policies could affect WTP through targeting the advancement of knowledge and acceptance of RE sources among Korean consumers who are characterized by low WTP comparative to other advanced nations (C.-Y. Lee & Heo, 2016). In this regard, the behavioral intentions toward the use of solar energy have been formed by willingness to pay, to change and to invest (Baharoon, Rahman, & Fadhl, 2016). As noted also by Baharoon et al (2016) there is a difference between the public's knowledge and attitudes toward the use of solar energy among urban and rural areas as a result of the factor of residence place (Baharoon et al., 2016).

Table 2. The factors influence moving toward RE adoption

Study	The factors of adopting RE	Customers	Country
(Sangroya & Nayak, 2017)	<ul style="list-style-type: none"> <li>• <i>Functional value</i> points out the perceived utility of a product by a capacity to execute its functions.</li> <li>• <i>Social value</i> means findings from the social perception of the products purchase and consumption by a customer in surrounding environment.</li> <li>• <i>Emotional value</i> refers to the emotions and feelings that a purchaser attaches to the product.</li> <li>• <i>Conditional value</i>, namely a utility that is drawn from a given situation such as government offer of subsidies.</li> </ul>	Industrial Consumers	India
(Noppers, Keizer, Milovanovic, & Steg, 2016)	<ul style="list-style-type: none"> <li>• <i>Instrumental attributes</i>, namely the utility of utilizing a sustainable innovation.</li> <li>• <i>Environmental attributes</i> refer to the outcomes of utilizing a sustainable innovation for environmental quality.</li> <li>• <i>Symbolic attributes</i> mean the impacts of utilizing sustainable innovations on one's social status and self-identity.</li> </ul>	Households	Netherlands
(Lee & Heo, 2016)	<ul style="list-style-type: none"> <li>• Estimates willingness to pay (WTP) for using various sources of RE.</li> <li>• RE policies can influence willingness to pay (WTP) through enhancing knowledge and acceptance of RE sources.</li> </ul>	Korean consumers	South Korea
(Bidwell, 2016)	<ul style="list-style-type: none"> <li>• Providing information to the members of the public.</li> <li>• Participation in an information session.</li> </ul>	The residents of coastal communities in Michigan	United States
(Fergen & B. Jacquet, 2016)	<ul style="list-style-type: none"> <li>- Expectations of wind farm</li> <li>- Degree of expectation satisfactions</li> <li>- Economic and environmental value</li> </ul>	The rural residents in the state of South Dakota (SD).	United States

Study	The factors of adopting RE	Customers	Country
(Zahari & Esa, 2016)	<ul style="list-style-type: none"> <li>- Environmental concern</li> <li>- Consumer beliefs</li> <li>- Consumer knowledge</li> <li>- Relative advantage</li> </ul>	The undergraduates are from one of the business schools in one of the Government-Linked University (GLU)	Malaysia
(Baharoon, Rahman, & Fadhl, 2016)	<ul style="list-style-type: none"> <li>- Public's knowledge</li> <li>- Personal observation and experience</li> <li>- Public's attitudes</li> <li>- Public's behavioral intentions</li> </ul>	Households	Yemen
(Yun & Lee, 2015)	<ul style="list-style-type: none"> <li>- <i>Direct factors</i>: "attitude - subjective norms - perceived behavioral control"</li> <li>- <i>Indirect factors</i>: "perceived social trust - perceived social support - perceived system quality - facilitating technical conditions"</li> </ul>	The residents of West and Midwest regions	United States
(Park & Ohm, 2014)	<ul style="list-style-type: none"> <li>- <i>Indirect factors</i>: "perceived trust – perceived benefits – knowledge – perceived risks"</li> <li>- <i>Direct factors</i>: "public attitude – perceived cost"</li> </ul>	The residents of six regions and 18 cities.	South Korea
(Alam et al., 2014)	<ul style="list-style-type: none"> <li>- Relative advantage</li> <li>- Cost</li> <li>- Perceived ease of use</li> <li>- Awareness</li> <li>- Perceived behavioral control</li> </ul>	Malaysian urban residents	Malaysia
(Zyadin, Puhakka, Ahponen, & Pelkonen, 2014)	<ul style="list-style-type: none"> <li>- General RE knowledge</li> <li>- Perceptions of RE implementation</li> <li>- Personal attitudes</li> </ul>	Secondary school teachers	Jordan

Source: Prepared by the researcher.

Few authors have mainly highlighted the relevance of the general customer knowledge and awareness regarding RE, for example, RE sources, benefits, drawbacks, technologies and so on. Meanwhile, these studies have claimed that more interest should be paid to RE knowledge and awareness by providing formal and informal education, giving information to the stakeholders and public members and encouraging the participation in an information session (Alam et al., 2014; Baharoon et al., 2016; Bidwell, 2016; Zahari & Esa, 2016; Zyadin,

Puhakka, Ahponen, & Pelkonen, 2014). Additionally, there are some researchers who have focused on investigation regarding the role of attitudes as one of RE critical factors, for instance, personal and public attitudes for changing attitudes toward RE use instead of conventional energy (Baharoon et al., 2016; Park & Ohm, 2014; Yun & Lee, 2015; Zyadin et al., 2014).

Similarly, RE benefits have been highlighted by some writers such as examining relative advantages relative to traditional energy, investigating the degree of expected advantages satisfactions and displaying more benefits related to applying RE (Fergen & B. Jacquet, 2016; Ferreira et al., 2018; Ito, 2017; Zahari & Esa, 2016). Moreover, there are other drivers associated with the use of RE as have been demonstrated by some studies such as environmental concern, consumer beliefs, perceptions of RE implementation, cost and perceived ease of use (Alam et al., 2014; Zahari & Esa, 2016; Zyadin et al., 2014).

#### **4. The Nature of RE Sector in the Egyptian Market**

There is no doubt that a few developing countries have achieved a sharp jump in RE investments rates over the last period, especially since the beginning of 2015 such as Egypt, Jordan and Kenya. For example, RE investments have leapt pointedly from zero in 2015 to almost \$ 700 million in 2016 in Egypt (McCrone, Moslener, D'Estais, & Grünig, 2017; REN21 Renewable Energy Policy Network for 21st Century, 2017). It may be due to the Egyptian government launch of several procedures and policies of RE to push organizations and households toward using one of the RE sources. For instance, permitting private electricity plants (for example, Solar energy plant) to be connected with the public grid (On-grid system), allowing the installation of separated private electricity plant from the utility grid (Off-grid system), launching net metering policy, which refers to the customer right regarding selling surplus electricity from the private electricity plant to government as well as granting the right of renting the public grid for transmitting generated electricity from private electricity plant to consumed places of electricity, and this policy is called "Independent power producer (IPP)" (BloombergNEF, 2018; Kotb, 2018; New & Renewable Energy Authority, 2018; Regional Center for Renewable Energy and Energy Efficiency (RCREEE), 2013; TSAGAS, 2017).

Furthermore, the Egyptian government targeted the decline of electricity subsidies, notably the energy-intensive industries and households for five years (2014-2019) (World Bank, 2017). For this reason, it may lead companies to lose their competitive advantage of pricing because of rising electricity costs. These findings may contribute to reduce revenues and increase costs of businesses, such as decreasing revenues of hotels for more than roughly 20% in 2014 (Aladassy et al., 2016). Additionally, firms may not accept the instability of electricity costs and disruption to electricity supply from time to time. Thus, they may accept a high initial investment of transition toward RE to avoid electricity costs in the long run. Conversely, the Egyptian customer fully depends on the government to provide electricity and may accept disruption to the electricity supply now and then and electricity costs, besides an inability or lack of desire to afford high initial costs of moving toward clean energy (Aladassy et al., 2016; McCrone et al., 2017; OECD/IEA and IRENA, 2017; World bank, 2017).



Consequently, some companies have been forced to adopt efficiency energy policies in their activities to save electricity, while there are a number of companies that owned private electricity plant by using one of RE sources. Despite the policies and procedures that have been implemented by the Egyptian government to encourage companies and households to use RE sources, there are few firms that have adopted RE as their electricity source. More clearly, the percentage of solar and wind energy has never exceeded 2.1% of the total of electrical energy production, whereas -as demonstrated in Figure 1 - that the consumption percentage of the industrial, agricultural and commercial sectors have reached roughly 41.1% of the total of electrical energy consumption (Arabic Egyptian Electricity Holding Company, 2016; Egyptian Electricity Holding Co, 2018). According to Solar Atlas that Egypt is rich in solar radiation annually. In addition, solar energy technology is available in the Egyptian market, as RE companies that provide services of installation, maintenance, supply of components (for example, solar cell, solar inverter, solar battery...) have reached more than 220 firms in the Egyptian market (Kosmopoulos, El-Askary, & Kazadzis, 2018; New & Renewable Energy Authority, 2018).

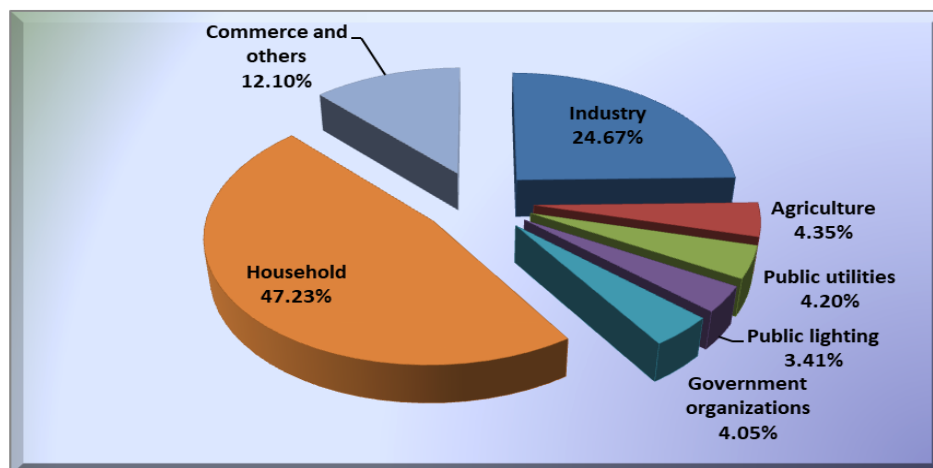


Figure 1. Distribution of electricity energy consumption for different purposes (2015/2016)

Source: Depending on Data from Arabic Egyptian Electricity Holding Company, 2016.

## 5. Research Design

The exploratory research was applied in this paper to understand how investors and decision-makers view the adoption of RE by exploring the factors that may influence the decision to adopt one of the RE sources in their organizations. Drawing on 1) theories and models used for explaining the adoption of RE in a literature review, 2) the drivers of adopting RE have been presented in the prior studies, 3) international and local reports have displayed the position of RE in the Egyptian market.

Eventually, the unstructured interviews were conducted by meeting some potential and actual business customers (investors and decision-makers), beside practitioners and academics in the RE sector, as the number of interviewees has reached 23 participants, whether face to face

meeting or online meeting (Saunders, Lewis, & Thornhill, 2016; Zikmund, Babin, Carr, & Griffin, 2009).

## 6. Conclusions and Recommendations

Overall, the findings of this paper demonstrate that the diffusion theory of innovations (DOI) is suitable to explain how RE can be diffused as a new product in the Egyptian community, because RE is considered in the first phase of the product life cycle (Rogers, 2003; World Bank, 2017). Furthermore, the Egyptian market needs both behavior and social change of decision-makers and investors toward the RE issue. Accordingly, DOI focuses on both social and behavior change, whereas most theories seek toward behavior change only (Rogers, 2003; Sharma & Mishra, 2014; World Bank, 2017). Moreover, investors and decision-makers are more likely to favor investments of the new ideas or issues like clean energy issue, as illustrated that DOI explains the behavior of adopters toward innovations such as innovators and early adopters (Y. Lee, Wang, Kao, Chen, & Zhu., 2010; Rogers, 2003). Additionally, Knowledge, community support and trustworthy communication channels are central elements to spread RE, as DOI demonstrated the significance of communication channels, knowledge and community support concerning the adoption of innovation (Dinica, 2006; Gatzert & Vogl, 2016; KPMG, 2017; Rogers, 2003). Meanwhile, DOI has been taking into consideration various aspects such as technological, social and behavioral dimensions that may affect the adoption of RE (Alam et al., 2014; Mani & Dhingra, 2012; Reyes-Mercado, 2017).

Generally, this research has observed that the emerging markets have never received more attention from researchers compared to developed markets, notably the countries, which have never been oil-rich, also characterized by a less developed economy, and less advanced industry. Meanwhile, they own at least one of the RE sources, in abundance such as the Egyptian market that possesses strong solar energy over the year, as well as being able to recycle the available waste continuously to generate electricity through applying bioenergy technology (Abdelhady, Borello, & Shaban, 2017; Atalay, Biermann, & Kalfagianni, 2016). Despite the importance of the role of investors and decision-makers for growing the diffusion of using RE in the various sectors, most studies have concentrated on the view of customers like households. At the same time, there has been little interest in the role of the commerce exchange between RE companies and the other firms for spreading RE in the societies by providing RE goods and services to the different organizations. Business-to-Business (B2B) can contribute to diffuse RE greatly in the Egyptian market (Claudy et al., 2013; Sangroya & Nayak, 2017; Uzialko, 2017). For instance, encouraging the real estate developers to adopt the solar energy in their projects, can lead to an increased acceptance of RE among customers.

Finally, the drivers found likely to be influencing the adoption of RE within businesses in the Egyptian market have been explored via this study. In the following, RE relative advantages should be maximized comparative to traditional energy such as the benefits of social, investment, marketing, environment and so on (Alam et al., 2014; Rogers, 2003). Hence, RE benefits should never be confined to the financial benefits as observed in the Egyptian market. Additionally, the social trust of investors and decision-makers regarding RE use inside their

organizations must be increased, as customers depend on specialized institutions in the case of adopting new technology such as RE technology when they have not enough knowledge (Yun & Lee, 2015). Therefore, the specialized institutions (for example, universities, research agencies and so on) should provide support to business customers by giving training, educational courses and consultants of RE aspects.

Accordingly, social community support surrounding investors and decision-makers is an important factor. Business customers will usually realize the importance of RE diffusion when a surrounding environment is supportive of the RE use and provides more knowledge about it (Yun & Lee, 2015). Thus, the specialized discussions must be organized concerning the RE benefits inside businesses by conducting meetings in such federations of industries, trade and industrial exhibitions, commerce chambers, business associations, and so on. In addition, knowledge and awareness are considered critical factors behind the adoption of RE within the Egyptian society. Consequently, it is necessary to boost the initiatives to raise awareness and improve the knowledge of RE investments opportunities by providing training, conferences, education, workshops, exhibitions and so on (Baharoon et al., 2016).

Furthermore, RE costs play an essential role in the decision to adopt RE instead of traditional energy inside businesses. Willingness to pay by business customers must be increased by maximizing the value of RE investment, as it has become almost equal to the RE costs, in which the RE adoption should influence positively on branding, organization performance and so on. Additionally, it is important to decrease the financial costs of RE use, particularly the initial costs of RE and reducing the non-financial costs such as opportunity cost, structural cost and so on (Donovan & Henley, 2010; Lee & Heo, 2016).

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