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Social media as a driver of the use of renewable energy: The perceptions of instagram users in Iran

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ABSTRACT

Despite political drivers, available solar and wind potentials, and other driving factors, the share of renewable energy sources in Iran's energy mix remains small. Many factors are perceived as barriers to the use of renewable energy sources and therefore influence the willingness of private households in Iran to use this kind of energy. We argue that social media not only plays an increasingly important role in perceptions of various technologies but also influences people's intentions. Therefore, our aim in this study is to understand whether and how social media influences people's intentions to use renewable energy sources. The research sample includes users of Instagram who are interested in and following information being posted on renewable energy sources. The methodology includes the use of a modified version of the extended parallel process model that includes attitude, intention, and trust in social media. The results of structural equation modeling show that the perceived risk of climate change significantly affects respondents' intention to use renewable energies. Also, perceived self-efficacy has a significant impact on attitude, intention, and use of renewable energy. Government agencies can increase the likelihood that household energy consumers will use renewable energy by using trusted channels to deliver necessary messages about the harms of using traditional energy and the low cost and ease of using renewable energy.

1. Introduction

Climate-related impacts, such as extreme weather events, natural catastrophes, and impacts on socioeconomic activities, have created an urgent need for climate change mitigation. Reduced use of carbon-intensive technologies in various sectors, including in the generation of electricity, is an important driver of climate change mitigation, as about 25% of global greenhouse gas (GHG) emissions are generated through the production of electricity (Maennel and Kim, 2018). One way to reduce the use of carbon-intensive technologies is to use renewable energy sources (RES). In many countries, RES are also important drivers of energy security. RES can be used to decarbonize the energy supply as well as to meet the growing demand for energy (Yazdanpanah et al., 2015a, 2021; Gökgöz and Güvercin, 2018). The electricity generated by RES is more than sufficient to satisfy the total global demand for energy: 3000 times current global energy needs can be generated from RES (Ellabban et al., 2014; Sütterlin and Siegrist, 2017). The availability of resources points to the positive development of RES and their strong potential for the future (Karatepe et al., 2012). By reducing their consumption of fossil fuels, especially coal, many countries are increasing the amount of renewable energy they generate. According to studies, a 10% increase in the use of renewable energy to generate electricity will lead to at least a 3% reduction in GHG emissions (Magiran, 2020).

It is estimated that global energy use will increase by almost 50% between 2019 and 2050 (EIA, 2019). Most of this growth will come from non-OECD countries and will be focused in areas where strong economic growth will stimulate demand, especially in Asia. The goals of mitigating climate change and increasing energy security by using a larger share of RES are supported not only at the international governance level but also by several countries through national strategies and action plans for increasing the use of RES. However, despite these drivers, total global fossil fuel emissions continue to increase at an average rate of 4% per year (Lin and Zhu, 2019).

Iran, which is located in the world's Sun Belt, has great potential to benefit from the use of solar energy. Iran has a total area of around 1.6 million km2, with about 300 clear sunny days a year and an average of

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2200 kWh solar radiation per square meter. There are more than 2800 h of sunshine in Iran each year. Thus, even if solar energy were absorbed from only 1% of Iran's area with 10% system efficiency for harnessing it, 9 million MWh of energy would be received daily from the sun (Larijani et al., 2015; Najafi et al., 2015).

Despite the great potential of solar energy in Iran, its use in the country is minimal. Currently around 99% of Iran's energy comes from oil and gas (Najafi et al., 2015). According to a SATNA report, the total capacity of renewable power plants, which has increased significantly in recent years, reached 845 MW by the end of 2020. As the total capacity of all power plants in the country is about 84,369 MW, renewable and clean power plants account for little more than 1% of the total capacity of the country. Counting more than 4530 household consumers as customers, solar power plants make up more than 55 MW of the total capacity of renewable and clean power plants in the country (Bagheri, 2021).

The deployment of RES is a complex and multidimensional process that is influenced by multiple factors (Irfan et al., 2020). Human factors are major drivers of the deployment of RES, and they must be understood to secure a sustainable energy future (Owens and Driffill, 2008). Large-scale use of RES depends on positive attitudes, perceptions, and acceptance of such technologies (Zyadin et al., 2012). People with a positive attitude toward RES may be willing to pay extra for electricity that comes from RES (Karasmanaki and Tsantopoulos, 2019; Lin and Syrgabayeva, 2016). Moreover, people's attitudes toward the use of renewable energy affect their intention to use it (Yazdanpanah et al., 2015a; Rezaei and Ghofranfarid, 2018; Fornara et al., 2016; Kim et al., 2014).

Nowadays, social media is playing a growing role in shaping people's perceptions of various events and processes. It has become an important social institution that, together with other media sources and social institutions, is helping to form the lifestyle expectations of various social groups (Siddiqui and Singh, 2016). Social media includes interactive Internet-based technologies based on the ideology and technology of Web 2.0, which enables the creation and exchange of user-generated content (Vinerean et al., 2013). The majority of people use social media platforms to read, publish, or broadcast news or update information (Wu et al., 2016). The openness of social networking platforms enables and motivates users to communicate freely over the Internet (Wu et al., 2016). People use social media not only for entertainment but also for education, business, and governance (Li and Sakamoto, 2014). Indeed, online social networks can be essential information and communication tools for youth. They can stimulate environmental movements by increasing people's awareness and knowledge of environmental problems and the actions they must take to reduce climate change (Robelia et al., 2011). Friends' recommendations or social media connections can also help consumers make decisions (Sema, 2013). However, without trust, people may not believe the information received from social media (Li and Wang, 2018). Trust is very important in helping users of social media gather relevant and reliable information. Therefore, trust in social media is a research topic with increasing practical importance. Trust provides evidence of those with whom we can share our information and from whom we can accept information without additional verification. Seeking information directly from trusted parties has two advantages: The information is not overwhelmed by excessive information (i.e., mitigated information overload), and access to credible information is increased (i.e., increased information credibility; Tang and Liu, 2015). Trust in information sources is dynamic and may vary from time to time, from one technology platform to another, or across different groups and individuals (Livio and Cohen, 2018). Hence, the purpose of this study was to understand whether and how trust in social media affects the perceptions and behaviors of people who are already aware of and interested in RES.

2. Background

2.1. The current state of energy and energy policies in Iran

Patterns of energy consumption in Iran are marked by very high consumption of fossil fuels, mainly because of the availability of fossil fuels in Iran and high energy subsidies from the government (Najafi et al., 2015). The abundance of resources hinders the introduction of energy-efficient measures and energy-saving behavior. Energy consumption in Iran is 36% higher than the global average and 27% higher than the average for the Middle East. The country's energy consumption was about 201.8 TWh in 2012, and it is expected to increase more than 2.5 times to 555.4 TWh by 2050. The energy consumption of private households has risen sharply since 2012 and currently accounts for 35% of the total energy consumption in Iran. This is approximately equal to electricity consumption in the industrial sector (Aghahosseini et al., 2018).

In general, energy production in the Middle East, including Iran, is dominated by low-cost fossil fuels whose use is socioeconomically expedient in the present but will create significant environmental and socioeconomic problems in the future (Aghahosseini et al., 2018; Nematollahi et al., 2016). Oil-exporting countries use more energy to promote economic growth than non-oil-exporting countries. Carbon emissions for the majority of MENA region countries exceed the global average. Energy accounts for nearly 85% of the Middle East's GHG emissions (Charfeddine and Mrabet, 2017).

The geographic location of the Middle East (including Iran) close to the equator and the North Stream makes RES an essential alternative to fossil fuels (Nematollahi et al., 2016). There are various types of RES, such as geothermal energy, biofuels, tides, and so on; wind and solar energy are available in the Middle East and are more accessible than the others (Mostafaeipour and Mostafaeipour, 2009). The abundance of RES enables these countries to build RES infrastructures to be independent of energy imports and to ensure a secure supply of energy to meet the growing demand (Nematollahi et al., 2016). In this regard, the Iranian government recently emphasized the consumption of renewable energy in various economic sectors, and energy policies have shifted from oil domination to the supply of diversified energy with more sustainable sources. The 20-year goal set by the government has been to support the private sector in operating renewable energy plants, developing technologies, accessing renewable energy in remote and rural areas, and increasing the share of renewable energy in industry (Aghahosseni et al., 2018). The potential of RES is recognized by the Iranian government, which recently took several measures and actions to stimulate the use of RES in various sectors of the economy. This has created the potential for Iran's energy policy to shift from an oil-dominant one to a more diversified energy mix (Aghahosseini et al., 2018).

At present, solar power plants make up the majority of the total planned capacity of renewable power plants at 48.75%, followed by wind (35.88%), small hydropower (12.52%), waste heat recovery (1.61%), and biomass (1.25%) power plants (Bagheri, 2021). Energy policy in Iran is driven by the government's plans for development. According to the Sixth Five-Year National Development Plan (2017–2021), the government is obliged to increase the share of RES in the domestic energy mix. Priority should be given to investments in domestic and foreign companies that aim to increase their use of RES. Altogether the use of RES should reach 5% by 2021 (Islamic Parliament Research Center of the Islamic Republic of IRAN- IPRCIRI, 2017). Because this aim had not been achieved by 2020, it is likely that it will be included in the Seventh Development Plan (2022–2026).

2.2. Behavioral factors, intention to use RES, and the modified extended parallel process model (EPPM)

The three sectors that use the most energy are construction (residential and commercial), industry, and transportation (Hasanuzzaman

et al., 2020). Construction, which includes lighting, heating, cooling, and air conditioning, accounts for nearly 40% of annual energy use (Omer, 2009). RES can meet household energy needs with the potential to provide energy services with zero or almost zero emissions of air pollutants and GHG (Qazi et al., 2019). There are many RES technologies for domestic use (e.g., solar thermal systems, micro-wind turbines, solar photovoltaics, wood-fueled stoves), but despite government encouragement to meet carbon reduction targets, few private households are willing to use RES (Caird and Roy, 2008; Alam et al., 2014). This willingness is essential for the further deployment of RES because developing RES depends on changing the voluntary behavior of consumers toward green electricity (Esteban et al., 2012). As Yazdanpanah et al. (2015a) pointed out, the development of renewable energy involves more than simply technical and economic capacity; laypeople and citizens play an important role in the energy transition. In this regard, researchers have noted that acceptance of RES is a socially oriented process in which people's perceptions play a pivotal role (Kardooni et al., 2016; Alam et al., 2014). Support for RES technologies is motivated by environmental concerns, especially concerns about climate change (Devine-Wright, 2007; Qazi et al., 2019; Lin and Syrgabayeva, 2016). In terms of the effects of media content, previous studies on environmental campaigns have reported that attention to effectiveness or threat messages has different effects on promoting environmental behavioral intentions (Yang et al., 2020). The varying effects of effectiveness and threat messages have been discussed extensively in the literature on the EPPM (Witte, 1992). A few studies describe how the EPPM performs when perceptions of threat and efficacy by one person or group affect their behavior related to another person or group (Askelson et al., 2015). Hence, this model has been used to investigate the effect of messages on the use of renewable energy. According to this theory, behavior change is a function of perceived risk, of how likely and severe someone perceives a threat and its consequences to be. However, behavior change might happen only if perceived risk is combined with perceived effectiveness, namely, if a person believes he or she can do something to mitigate the risk or its consequences.

Further research on the impacts of risk perceptions on behavior change was done in light of applications of the EPPM and its iterations (Rhodes, 2017). The EPPM acts as a message design model (Chen and Yang, 2018) and explains when and why a message works or fails (Witte and Allen, 2000). The theory has been widely used in behavioral economics to examine media messages in regard to health risks, including in research on preventive dental visits (Askelson et al., 2015), intention to perform breast self-examinations (Chen and Yang, 2018), treatment of meningitis (Gore and Bracken, 2005), intention to have a vaginal delivery (Hajian et al., 2015), obesity management behaviors (Hosseii-Amiri, 2018), and self-care behaviors against air pollution among pregnant women (Jasemzadeh et al., 2016). The EPPM has also been modified for research on tourism (Liu et al., 2016), the impacts of beliefs on waste separation behaviors (Abbasi et al., 2020), global warming (Li and Sakamoto, 2014), and green energy (Hartmann et al., 2014, 2016). We believe that applying the EPPM in the field of renewable energy can increase knowledge in this area. To the best of our knowledge, this is the first study to use this theory to predict the use of RES among Iranian users of social media.

Our study addresses several gaps in the research. First, previous research focuses on public acceptance of RES. However, although many recent works have focused on the social acceptance of RES in developing countries (Komendantova and Yazdanpanah, 2016; Hanger et al., 2016; Komendantova et al., 2012), most studies have been conducted primarily in developed countries that have made good progress in the development of RES (Liu et al., 2013; Lin and Syrgabayeva, 2016). Second, studies focus on acceptance and drivers of acceptance, but they do not research the impacts of social media. Therefore, this study uses the EPPM to investigate the relationship between perceptions of social media impacts and the use of RES. We assume that trust in social media can shape perceptions of risk, and thus we consider it a predictor of perceived threat. In particular, this study focuses to explore the perception of Instagram effects on the use of RES. Instagram is one of the most popular social networks, with about 1.082 billion active users (www.statista.com). Many people believe that it helps them to understand, learn, and share information instantly. Some people even say that Instagram makes the world seem like a small village (Ferrara et al., 2014). Instagram is popular in Iran, where 27% of the population prefer this social media platform to other social networks such as Facebook, YouTube, and Telegram.

2.3. The EPPM

To investigate the effects of social media on the use of RES, we rely on the EPPM, which was introduced in 1992 by Kim Witte. This model uses a dual process to explain how individuals perceive and respond to risk messages (Gore and Bracken, 2005). The EPPM addresses such issues as risk control versus fear control or risk perception. The beginning of the risk control process leads to adaptive responses (e.g., message acceptance), whereas the risk perception process leads to maladaptive responses (e.g., message rejection; Hong, 2011). Thus, appraisals of risk control and risk perception will lead to one of three outcomes: (1) no response, (2) message acceptance, or (3) message rejection (Witte et al., 2001). When perceived threat and perceived efficacy are high, the recipient of a message is expected to cognitively manage the threat and use the recommended responses to avoid the threat in the risk control process (Shi and Smith, 2016). However, when perceived threat is high but perceived efficacy is low, the risk perception or fear control process is expected to dominate. When controlling fear, people react emotionally to the threat and do not use the recommended responses. They may display maladaptive behaviors and avoid threatening information. However, no message processing will occur if the perceived threat is not high enough (Shi and Smith, 2016). This model shows that threat and efficacy may motivate responses (Hart and Feldman, 2016). To this end, fear appeal messages should convey perceived threat and perceived efficacy (Chen and Yang, 2018). The EPPM assumes that persuasive messages with a high level of threat should include efficacy information to create attitude and behavior change to avoid threats (Hart and Feldman, 2016; Witte and Allen, 2000).

The EPPM defines a threat as something that is dangerous or hazardous to people. However, it is important that threats not be confused with actual harms that trigger reactions. A threat is connected to a mental perception of danger (Chen and Yang, 2018). The threat is determined by two factors: perceived susceptibility and perceived severity. Perceived susceptibility refers to the likelihood of a threat affecting a particular person (Hong, 2011) or the possibility of experiencing a threat. In other words, it refers to a person's belief that he or she is likely to suffer a bad outcome (Askelson et al., 2015). Perceived severity is related to the perception of how bad a particular outcome will be (Askelson et al., 2015). It refers to the expected damage from a threat (Hong, 2011) and the individual's understanding of the magnitude and seriousness of the threat (Shi and Smith, 2016).

The role of efficacy information as a driver of behavior change is at the center of the EPPM, as it can predict potential effects of fear appeal messages (Hart and Feldman, 2016). Efficacy consists of perceived response efficacy and perceived self-efficacy. Response efficacy is the extent to which an individual believes that a remedy, treatment, or behavior is effective at reducing adverse outcomes (Chen and Yang, 2018; Hart and Feldman, 2016). Self-efficacy reflects how confident an individual is that he or she can perform an essential behavior to avoid negative outcomes (Tajei Moghadam et al., 2020; Askelson et al., 2015; Bozorgparvar et al., 2018; Savari et al., 2021; Pakmehr et al., 2020, 2021; Zobeidi et al., 2021). It is defined as an individual's personal belief in his or her ability to perform behaviors recommended by messages (recommended behavior change; Hart and Feldman, 2016; Chen and Yang, 2018). According to the EPPM, efficacy information helps people feel empowered to overcome a threat and in turn encourages

conservation behavior to reduce the threat. If efficacy is low, people are exposed to risk instead of trying to minimize the threat and use defense mechanisms (Hart and Feldman, 2016) or maladaptive behaviors to control their emotions.

2.4. Modification of the EPPM

For this study, we added three variables—attitude, intention, and trust in social media—to the original EPPM. In a meta-analysis, Witte and Allen (2000) concluded that EPPM variables can directly affect people's attitudes, intentions, and behavior. Various studies have used the EPPM to examine whether risk messages are successful at changing people's attitudes and behaviors in areas such as physical activity (Hatchel et al., 2013), obesity management (Hosseini-Amiri et al., 2018), and global warming (Li and Sakamoto, 2014). According to the theory of planned behavior (Ajzen and Fishbein, 1975), attitude is expected to influence intention. Many studies have confirmed the impact of attitudes on the intention to use renewable energy or save energy (Park and Ohm, 2014; Yazdanpanah et al., 2015a; Halder et al., 2016; Chen, 2016; Tan et al., 2017). In addition, intention is an important determinant of behavior. Indeed, studies have confirmed that attitude has a significant effect on the behavior of using renewable energy by mediating intention (He et al., 2021).

We added trust in social media to the model as a direct predictor of perceived threat. Trust is crucial for dealing with an uncertain and uncontrollable future (Kim et al., 2008). The relationship between trust and perceived threat can be positive or negative depending based on the context. For example, studies on online shopping (Kim et al., 2008; Marriott and Williams, 2018; Leerapong, 2013) have shown that increased trust in the Internet, electronic commerce, and mobile shopping leads to a reduction in perceived risk among people shopping online. According to Fang et al. (2012) trust in information sources positively affects risk perception. Fang et al. (2012) pointed out that a lack of public trust in information sources leads to a disvaluing of information and reduces perceived risk. Thus, we expect that trust in social media will positively affect perceived susceptibility and severity. Fig. 1 shows the modified framework of the EPPM.

3. Methodology

3.1. Participants and procedures

We examined the interdependencies among trust in social media, EPPM constructs, attitude, intention, and the use of renewable energy. The content of Instagram pages was examined to select pages rich in information on climate change risks and the need to use renewable energy. Respondents were randomly selected from among the followers of these pages.

Several items were used to measure each of the EPPM constructs. Numerous items were extracted from previous studies and modified to fit the current research context. Based on our literature review, we focused on eight variables: trust, perceived susceptibility, perceived severity, self-efficacy, perceived response efficacy, attitude, intention, and the use of RES. Table 1 summarizes the items and variables in the study. Our survey used a 5-point Likert scale ranging from strongly disagree (1) to strongly agree (5) to measure the variables.

3.2. Data analysis

Structural equation modeling (SEM) with the maximum likelihood algorithm in AMOS was used to examine the research hypotheses and the robustness of the modified EPPM for explaining the use of renewable energy. SEM is usually used to validate hypothetical or theoretical models (Hair et al., 2010). It is a set of statistical techniques that allow researchers to evaluate the relationship between dependent and independent variables (Ullman and Bentler, 2012). SEM can be used to calculate measurement error as well as simultaneously estimate model path coefficients. Reliability can also be calculated by estimating and eliminating measurement error (Ullman and Bentler, 2012). In addition, SEM is based on standard assumptions of linearity, normality, and additivity (Bayard and Jolly, 2007).

SEM is performed in two steps. The first step, confirmatory factor analysis, involves evaluating the suitability of the measurement model, and the second step involves creating the structural model (Gerbing and Anderson, 1988). Therefore, we first performed confirmatory factor analysis to evaluate the quality and appropriateness of the measurement model by checking reliability, convergent validity, and discriminant validity. Then, after the measurement model was confirmed, we performed structural modeling.

3.3. Verification of the model

Internal consistency and reliability were examined with Cronbach's alpha and composite reliability (CR). As shown in Table 2, all Cronbach's alphas and CR values were greater than 0.70 (Hair et al., 2010). Convergent validity was assessed with three indices with standard cut-offs (factor loading >0.5, CR > 0.7, and average variance extracted [AVE] >0.5).

To confirm the measurement model, the ratio of chi-square to the degrees of freedom should be less than 3 (Hair, 2006), the comparative fit index and normed fit index should be greater than 0.9 (Jörreskog and Sörbom, 1996), and the root mean square error of approximation should

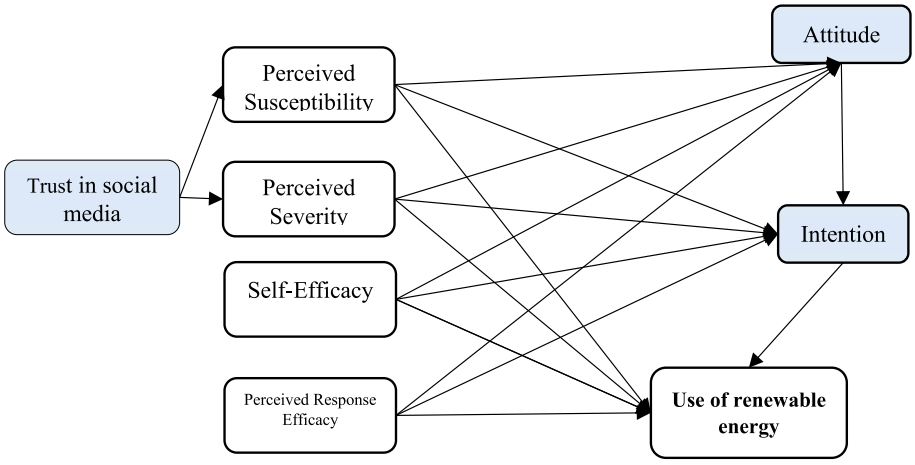

Fig. 1. The modified extended parallel process model.

Table 1
Survey items, means, standard divisions, and factor loadings.

Construct and item	Factor loading	Source
Perceived susceptibility (M = 3.59, SD = 0.81)		Witte and Allen (2000)
I think the use of fossil fuels is likely to pollute the environment.	0.74	Yoon and Kim (2016)
I think the use of fossil fuels is likely to harm my health.	0.76	Bockarjova and Steg (2014)
I think relying on fossil fuels is likely to disrupt the country's development.	0.82	
I think relying on fossil fuels is likely to hurt economic growth.	0.85	
Perceived severity (M = 2.45, SD = 0.79)		Witte and Allen (2000)
I think the use of fossil fuels is very harmful to society.	0.76	Bockarjova and Steg (2014)
I think using fossil fuels is very damaging to me and my family's health.	0.86	
I think using fossil fuels will cost me dearly, such as gas bills, gasoline, and so on.	0.69	
Self-efficacy (M = 2.96, SD = 0.89)		Hart and Feldman (2016)
I think I am as well informed about renewable energy resources as most people.	0.71	Witte and Allen (2000)
I feel that I know enough about installing renewable energy systems.	0.75	Bockarjova and Steg (2014)
I consider myself to be well qualified to use renewable energy.	0.79	
I feel that I have a pretty good understanding of renewable energy.	0.82	
I feel confident that, if I wanted to, I would be able to use renewable energies.	0.78	
I can use renewable energy to generate electricity.	0.68	
Response efficacy (M = 3.84, SD = 0.78)		Hart and Feldman (2016)
I think using renewable energy would be contribute in improving environmental problems.	0.73	Bockarjova and Steg (2014)
I think using renewable energy would be effective in reducing the negative impacts of climate change.	0.83	
I think using renewable energy would be effective in reducing greenhouse gas emissions.	0.82	
I think using renewable energy would be effective in reducing costs and expenses.	0.68	
I think using renewable energy would be effective in reducing other environmental problems.	0.70	
Intention (M = 2.71, SD = 0.82)		Yazdanpanah et al. (2015a)
I plan to use renewable energy in my life.	0.71	Bakhtiyari et al. (2017)
I will try to use renewable energy.	0.81	
I would like to discuss renewable energy with other people.	0.85	
I intend to encourage others to use renewable energy in their lives.	0.78	
Attitude (M = 3.54, SD = 0.83)		Yazdanpanah et al. (2015a)
I think that using renewable energy is interesting.	0.79	
I think that using renewable energy is important.	0.79	
I think that using renewable energy is favorable.	0.84	
I think that using renewable energy is wise.	0.72	
Use of renewable energy (M = 2.58, SD = 1.00)		Witte and Allen (2000)
I use renewable energy.	0.78	
I have installed a renewable energy system at home.	0.92	
I have never used renewable energy.	0.82	
Trust in social media (M = 2.53, SD = 0.81)		Hajli et al. (2017)
Instagram is reliable.	0.75	Shen et al. (2013)
Instagram can be trusted; there are not many uncertainties.	0.70	Cheung & Lee (2006)
Anyone who trusts Instagram is helping himself/herself.	0.90	
I trust the information provided by Instagram.	0.85	

Note: Respondents were asked to rank their agreement with each statement on a scale from 1 (strongly disagree) to 5 (strongly agree) after seeing or reading any message on Instagram that was somehow related to renewable energy. No samples of text or images from Instagram are provided in the survey, respondents are required to access content from memory.

be less than 0.08 (Hair et al., 2010). As shown in Table 2, the measurement model had acceptable goodness of fit.

We assessed discriminant validity by comparing the correlation coefficients and square roots of the AVE for each variable. Table 2 indicates that all square roots of the AVE were greater than the off-diagonal elements. Therefore, the discriminant validity of the variables was confirmed.

Multicollinearity between independent variables can significantly distort the results. We used several indicators to check for multicollinearity, including Pearson correlations, the variance inflation factor (VIF)/tolerance, and the Durbin-Watson statistic. Pearson correlations between independent variables should not be greater than 0.8. As Table 2 shows, no correlations between variables exceeded 0.8. A standard cutoff is a tolerance value of 0.10, which corresponds to a VIF above 10. The VIFs for all independent variables ranged from 1.43 to 2.70, and the tolerance for all independent variables ranged from 0.37 to 0.69. Finally, the acceptable range for the Durbin-Watson statistic is between 1.5 and 2.5. In this study, the Durbin-Watson statistic was 2.084, within the acceptable range. All of this indicates that multicollinearity was not a problem in this study.

3.4. Sample

The data were collected through an online survey implemented in May 2020. The sample included users of Instagram. The 173 people in the sample were selected using random sampling. First Persian pages on solar energy were identified, and then random sampling was performed on followers of these pages (samples were selected that were associated with information about renewable energy through Instagram). After respondents were selected through means such as email and social networks, they were sent a link to the questionnaire, and the data were collected. The average time required to complete the questionnaire was 19.52 min, and the response rate was 41%. Table 3 and Fig. 2 show the demographic characteristics of the respondents, which included the following:

- Home ownership: 26% (45) of respondents were tenants, 65.3% (113) were homeowners, and 7.8% (15) did not answer this question.
- Type of house: 46.8% (81) of respondents lived in an apartment, 45.1% (78) lived in a house, and 8.1% (14) did not answer this question.
- Sex: 43% (74) of respondents were male, and 57% (99) were female.
- Age: participants ranged in age from 13 to 60, with a mean age of 30.71 years (SD = 8.57)
- Education: of the 173 participants, 1.8% (3) had a middle school degree, 2.9% (5) had a high school degree, 4.6% (8) had a diploma, 4.6% (8) had an associate's degree, 33.5% (58) had a bachelor's degree, 30.6% (53) had a master's degree, and 22% (38) had a PhD.
- Family size: the mean family size was 4.37 (SD = 2.06; minimum = 1, maximum = 18).
- Use of social media: respondents used social media an average of 155.61 min per day (minimum = 10 min, maximum = 680 min per day); the main tool used to collect data was Internet sites (59%, 101) followed by social networks (26%, 45).

4. Results

4.1. Measurement model

Table 4 shows the goodness-of-fit indices for the modified EPPM.

Table 2
Correlations, reliability, and validity.

Construct	AVE	CR	α	Trust	Perceived susceptibility	Perceived severity	Perceived self-efficacy	Perceived response efficacy	Attitude	Intention	Use of renewable energy
Trust	.725	.913	.873	***.851***							
Perceived susceptibility	.722	.912	.872	.22**	***.849***						
Perceived severity	.706	.878	.790	.19**	.78**	***.840***					
Perceived self-efficacy	.660	.921	.897	26**	.42**	.40**	***.812***				
Perceived response efficacy	.648	.902	.866	.10	.39**	.40**	.34**	***.804***			
Attitude	.714	.909	.866	.28**	.46**	.38**	.45**	.54**	***.844***		
Intention	.711	.908	.865	.60**	.19**	.11	.29**	.24**	.42**	***.843***	
Use of renewable energy	.802	.924	.876	.40**	.23**	.28**	.58**	.25**	.36**	.44**	***.895***

Note: Elements on the diagonal are the square root of the AVE. AVE, average variance extracted; CR, composite reliability. *p < 0.01, **p < 0.05.

Table 3
Sociodemographic characteristics.

Variable		n	Valid percentage (%)
Gender	Male	74	42.8
	Female	99	57.2
Age	Younger than 25	48	24.1
	25–35	82	35.9
	36–45	34	14.6
	46–55	6	15.9
	56 or older	3	9.5
Education	Middle school	3	1.8
	High school	5	2.9
	Diploma	8	4.6
	Associate's degree	8	4.6
	Bachelor's degree	58	33.5
	Master's degree	53	30.6
	PhD	38	22
Home ownership	Owner	113	71.5
	Tenant	45	28.5
Type of house	Detached house	78	49.1
	Apartment	81	50.9

Contrary to expectations, chi-square was significant ($p = 0.000$). Because chi-square is sensitive to sample size, it is not a good indicator to assess of goodness-of-fit Therefore, the adequacy of the model was assessed with other fit indices (Joreskog and Sorbom, 1996). A comparative fix index, incremental fit index, or goodness-of-fit index above 0.9 (0.8–0.9 marginal levels); a root mean square error of approximation of 0.03–0.08; and a relative chi-square (chi-square/df) equal to or less than 3 are considered acceptable (Hair et al., 2010). In general, the results for the EPPM indicated acceptable fit. Means, standard deviations, and factor loadings for the measurement model are shown in Table 1.

4.2. Structural model

The estimated structural model had good fit according to different indices (Table 4). As Fig. 3 shows, the latent independent variables predicted 47%, 22%, and 59% of the variance in attitude, intention, and use of renewable energy, respectively.

Trust in social media had a positive effect on perceived susceptibility and perceived severity (both $\beta s = 0.27$, $p < 0.001$). Perceived susceptibility had a positive effect on attitude ($\beta = 0.53$, $p < 0.05$). Self-efficacy ($\beta = 0.29$, $p < 0.0001$) and perceived response efficacy ($\beta = 0.49$, $p < 0.0001$) had a positive effect on attitude. Perceived severity and self-efficacy were positively associated with intention ($\beta s = 0.45$ and 0.25, respectively, $p < 0.05$). Finally, perceived susceptibility, perceived severity, and perceived self-efficacy were positively associated with use of renewable energy ($\beta s = 0.60$, 0.62, and 0.51, respectively, $p < 0.01$). Attitude had a direct positive effect on intention ($\beta = 0.23$, $p = 0.015$). Intention had a significant effect on behavior ($\beta = 0.41$, $p < 0.0001$) (Table 5).

5. Discussion

We investigated the impact of social networks on attitude, intention, and behavior in terms of using renewable energy (solar energy). The effect of trust in the social network in predicting perceived threat (perceived severity and perceived susceptibility) was investigated. The results of SEM showed that the modified EPPM was able to predict 47% of the variance in attitude, 22% of the variance in intention, and 59% of the variance in behavior.

Results showed that trust in social media can significantly affect both perceived severity and perceived susceptibility. People who had more trust in Instagram perceived a greater threat after receiving messages about the adverse consequences of using conventional energies. In various studies, trust in information sources has been studied usually through trust in scientists, experts, government and institutions, radio and television, the Internet, and environmental associations. These studies confirm that trust in information sources influences perceptions of threat and risk (Cologna and Siegrist, 2020; Fang et al., 2012; Carvalho, 2008; Kim et al., 2008).

Among the indicators of perceived threat, only perceived susceptibility had a significant effect on individuals' attitudes. Perceived susceptibility is defined as a person's perception of the potential threat of a serious problem. Here it refers to potential economic and environmental damage caused by the use of fossil fuels and conventional energies. People with a higher perceived susceptibility to using fossil fuels after reading messages had a more positive attitude toward using RES.

Previous studies using the EPPM, such as De Hoog et al. (2007), have shown that perceived severity and perceived susceptibility are perceived as separate dimensions of threat and that each has a significant but unique effect on attitude. Liu et al. (2013) showed that environmental concerns can affect people's attitudes toward the use of renewable energy. A study on green advertising showed that people with higher perceived sensitivity had a more positive attitude (Yoon and Kim, 2016). This relationship is also consistent with other research (Li and Sakamoto, 2014; Hosseini Amiri et al., 2018).

Perceived response efficacy, another predictor of attitude, refers here to people's perception of the effectiveness of using renewable energy to reduce environmental problems. People who feel that using solar energy reduces GHG emissions have a better attitude toward using solar energy. Li (2014) showed that the effectiveness of the response can affect people's attitudes toward low-carbon behaviors.

Self-efficacy had a significant positive effect on attitude, which is consistent with the research (Erdem, 2015). Self-efficacy in this context is the belief that one has the capacity to act against climate change.

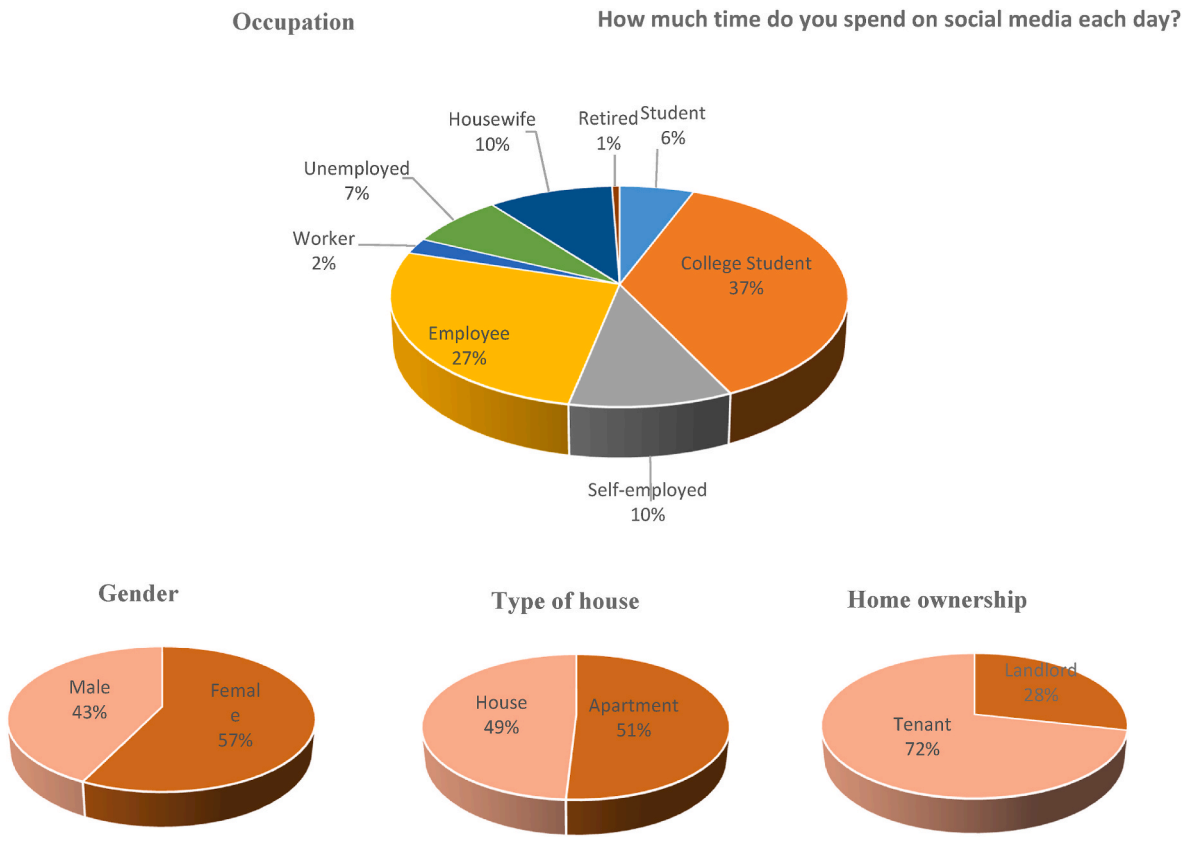

Fig. 2. Respondent profile.

Table 4
Fit indices of the models.

Models	χ^2	df	p	χ^2/df	GFI	CFI	IFI	NFI	RMSEA
Measurement model	512.840	462	0.0001	1.543	0.811	0.929	0.931	0.825	0.056
Structural model	737.953	467	0.0001	1.580	.806	.924	.925	.819	.058

Note: GFI, goodness-of-fit index; CFI, comparative fit index; IFI, incremental fit index; NFI, normed fit index, RMSEA, root mean square error of approximation.

Information that can enhance self-efficacy in the use of renewable energy, such as information about how to use and install renewable energy systems or the cost of using renewable energy, informs a positive attitude toward the use of RES.

According to the findings, perceived severity can affect people's intentions to use RES. This result is consistent with previous research (Hajian et al., 2015; Hartmann et al., 2016; Chen and Yang, 2018).

Self-efficacy also had a significant positive effect on intention. In this regard, Li (2014) and Yazdanpanah et al. (2015b) showed that self-efficacy has a direct relationship with the intention to reduce carbon emissions and use RE. However, perceived response efficacy did not have a significant effect on intention. In contrast, Bang et al. (2000) found that knowledge of the effectiveness of renewable energy and understanding of the consequences of society's continued use of conventional energy sources may make consumers more willing to pay for renewable energy. In addition, studies have shown that perceived behavioral control affects willingness to pay or use renewable energy (Alam et al., 2014; Liu et al., 2013).

Attitude is another factor that can affect people's intentions to use RES. Previews studies have confirmed the effect of attitude on intention (Rezaei and Ghofranfarid, 2018; Liu et al., 2013; Yoon and Kim, 2016). Therefore, using social media to form positive attitudes toward the use of renewable energy is very important, because it could very well lead to behavioral change.

According to the findings, perceived susceptibility and perceived severity can affect the use of RES. Hong (2011) confirmed that these variables mediate the effect of health consciousness on message acceptance. Janmaimool (2017) also found that perceived susceptibility and severity affect the use of RES.

As predicted, intention was a powerful predictor of behavior. Previous research proves the effect of intention on environmental behavior (Liu et al., 2013; Liao et al., 2020). Behavioral intention provides a useful perspective for encouraging people to use renewable energy. Intention has a mediating role that is directly influenced by attitude and the original EPPM constructs. Given that social media has become an important source of information for communicating risk, especially around environmental problems, the information in social media can provoke fear. In fact, after receiving a message, the recipient performs a threat appraisal. Messages that include threats about the dangers of consuming conventional fuels, such as increasing GHG emissions or economic dependence on fossil fuels, can be provided to people in this stage. Part of the information should address the effectiveness of environmentally friendly behaviors such as using RES. Indeed, at this stage, efficacy is appraised. A meta-analysis examined the power of fear in modifying behavior and found that attractive and well-designed messages that included both efficacy and threat appeals were more persuasive than other messages (Tannenbaum et al., 2015).

These studies have various limitations. First, RES use is self-reported.

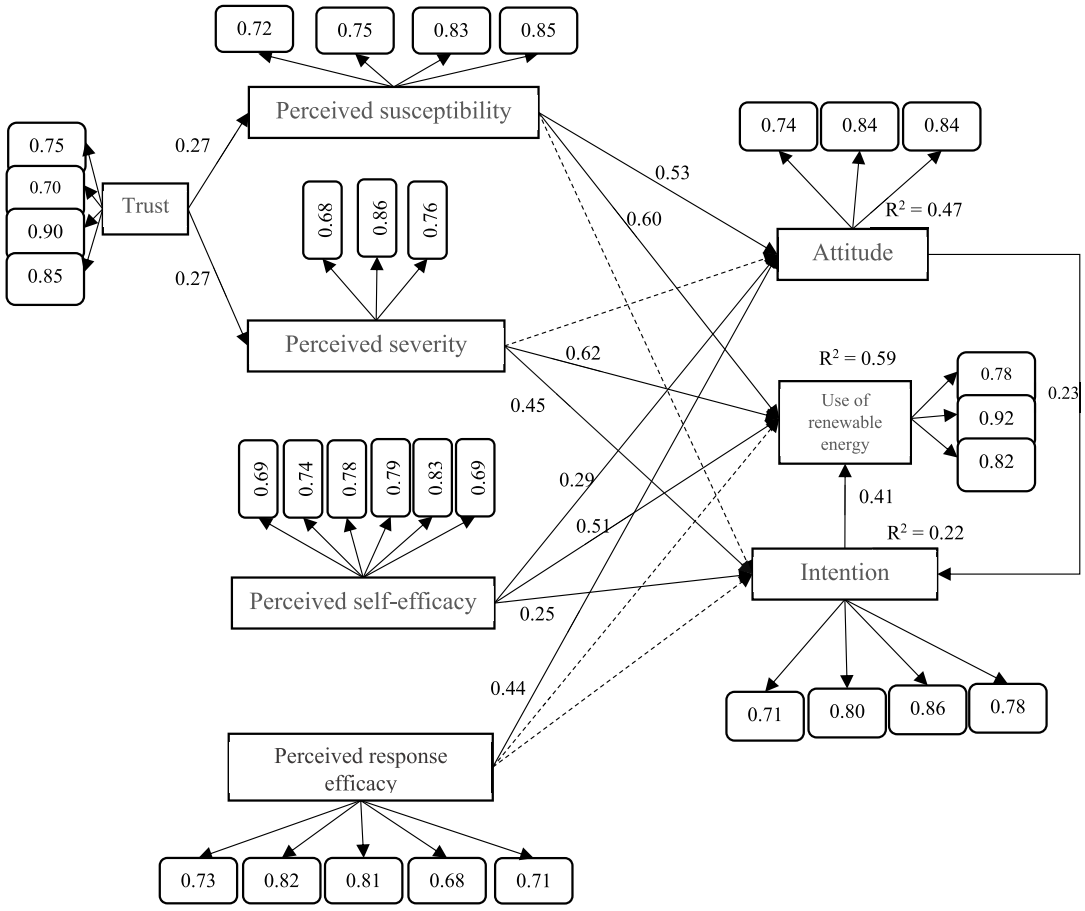

Fig. 3. Results of structural equation modeling. Dashed lines indicate nonsignificant relationships. Solid lines indicate significant relationships.

Table 5
Estimates of the structural model.

Hypothesis			Unstandardized Regression Weight	SE	Standardized Regression Weight	CR	p	Result
Trust in social media	→	Perceived susceptibility	.245	.079	.269	3.122	.002	Supported
Trust in social media	→	Perceived severity	.244	.080	.269	3.055	.002	Supported
Perceived susceptibility	→	Attitude	.606	.268	.543	2.264	0.024	Supported
Perceived severity	→	Attitude	.349	.266	.306	1.312	.190	Rejected
Perceived self-efficacy	→	Attitude	.305	.089	.285	3.417	***	Supported
Perceived response efficacy	→	Attitude	.483	.095	.438	5.104	***	Supported
Perceived susceptibility	→	Intention	.293	.249	.271	1.179	.239	Rejected
Perceived severity	→	Intention	.493	.245	.453	2.008	.045	Supported
Perceived self-efficacy	→	Intention	.250	.094	.245	2.652	.008	Supported
Perceived response efficacy	→	Intention	.112	.102	.106	1.095	.274	Rejected
Perceived susceptibility	→	Use of renewable energy	.780	.325	–.579	2.403	.016	Supported
Perceived severity	→	Use of renewable energy	.809	.326	–.615	2.479	.013	Supported
Perceived self-efficacy	→	Use of renewable energy	.631	.113	.512	5.558	***	Supported
Perceived response efficacy	→	Use of renewable energy	.058	.094	–.046	.619	.536	Rejected
Attitude	→	Intention	.215	.098	.225	2.197	.028	Supported
Intention	→	Use of renewable energy	.494	.107	.409	4.637	***	Supported

Note: CR, composite reliability. ***$p < 0.001$.

If individuals' behaviors are measured by the type of behavior or the frequency of use of renewable energy, more reliable results will be obtained.

Second, the use of the survey method seems to make it more challenging to investigate the effect of messages. Therefore, in this study we assessed people's mental appraisal of the impact of messages on their perceptions and rather than the objective or actual effects. It is recommended that experimental designs (e.g., Chen and Yang, 2018) be used in addition to surveys.

A final limitation of the research relates to the selection of research samples. Because respondents must be exposed to social media messages to examine the effect of messages with the least amount of bias toward the experimental design, it is recommended that researchers identify the number of people who liked or viewed the relevant posts. Moreover, it is suggested that future studies include more respondents, which requires more time and effort than was possible in this study.

6. Conclusion and implications for practice

This study has several important findings with empirical

implications. The results showed that trust in social media can affect people's perception of risk. Hence, when people are confident in their information source (here Instagram), their acceptance of information will increase, and as a result they will show better attitudes, intention, and behaviors.

Even a small amount of negative information from multiple posts can have a significant impact on consumer attitudes (Schlosser, 2005). False and contradictory information can create a lack of trust in information sources. However, social media may also provide an opportunity to combat misinformation (Bode & Vraga, 2015).

In the field of RES, a lot of misinformation is circulating on social media (Wengenmayr and Bührke, 2011). Fake news and false information are inadvertently spread by well-meaning users who do not thoroughly examine the evidence and facts. Such misinformation can be devastating because it undermines trust (Wu et al., 2016). Because trust in an information source can increase the likelihood and severity of perceived harm, the government needs to prioritize trust in the media on its agenda. Providing accurate information about problems and energy prices and preventing the release of misinformation can increase trust in the media. Trusted media can then provide necessary information about the adverse economic, social, and environmental consequences of GHG emissions for current and future generations. Honest information on the costs associated with transitioning to renewable energy, government assistance in this area, and consumers' share of the cost should be provided so people move toward behavior change. Because the relationships between trust in social media and perceived susceptibility and severity are positive, we suggest that environmental activists consider these means of maintaining and increasing trust. Because different groups, such as the public sector, private solar companies, and environmental activists, are spreading information on social media and encouraging people to install and use renewable energy, it is not possible to provide a single piece of advice for all groups. However, each group needs to gain people's trust as a first step. Providing accurate information or announcing accurate and up-to-date costs along with evidence and real statistics can increase people's trust in an information provider. In addition, because research shows that people tend to be biased toward interpreting new information based on their cultural predispositions, values, and worldviews, scientists and others need to consider the importance of value similarity when expressing their findings in an effort to increase trust.

Perceptions of risk can greatly improve attitudes, intention, and use of renewable energy. Therefore, when preparing a message to persuade a specific group of people, designers should use a threat message that attracts the audience's attention and warns them of possible dangers (Chen and Yang, 2018). Groups such as private companies can focus on economic problems, increased costs of traditional energy, and savings from installing solar energy systems, whereas environmental groups can provide information about environmental hazards, risks to personal health, or the loss of biodiversity due to climate change and rising GHG to increase people's perception of risk. On the whole, it is suggested that social media provide audiences with extensive information about the harms and threats of fossil fuel use. Persuasive efforts should focus on disseminating knowledge through information-based campaigns that increase recognition of renewable energy and in turn lead to stronger beliefs about the salient consequences of using it. In this regard, advertising campaigns that identify local suppliers of renewable energy; compare the price of renewable energy with that of conventional energy; or provide information on the release of GHG emissions from fossil fuel power plants, ozone depletion, global warming, or economic threats can shed light on many facts for consumers.

Response appraisals by the audience influence attitude, intention, and use of renewable energy. To receive more responses in favor of renewable energy consumption, government agencies can collaborate with trained users of renewable energies and provide them with ongoing feedback to identify problem areas and take steps to correct them. To increase the popularity of and demand for renewable energy among domestic users, governments can use standard and robust policies as well as financial incentives and subsidies. Also, availability and low cost are essential factors that increase perceived efficacy and should be considered when introducing renewable energy. Attitude and intention also have significant influences on the use of RES. To improve people's attitudes and intention, it is necessary to give people valuable information about the benefits of using RES.

CRediT authorship contribution statement

Tahereh Zobeidi: Conceptualization, Methodology, Software, Formal analysis, Investigation, Writing – original draft, Writing – review & editing. **Nadejda Komendantova:** Supervision, Conceptualization, Methodology, Software, Formal analysis, Investigation, Writing – original draft, Writing – review & editing. **Masoud Yazdanpanah:** Supervision, Conceptualization, Methodology, Software, Formal analysis, Investigation, Writing – original draft, Writing – review & editing.

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.

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